Consumerism in the Late Eighteenth Century: The Treatment of Disposed Tobacco Pipes from the Mount Pleasant Site (46JF215) Jefferson County, West Virginia

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ABSTRACT

Excavations at historic sites often result in the recovery of an abundance of white clay tobacco pipe fragments. There are several theories that explain why large quantities of stem fragments are recovered from sites; however, no systematic studies have been done to evaluate these theories. The 1999 cultural resources field investigation in Jefferson County, West Virginia uncovered a rural homestead, the Mount Pleasant Site (46JF215), as well as an artifact assemblage that includes 171 pipe bowl fragments and 396 stem fragments. To determine if there are patterns that explain how pipe stems were broken, the stem fragments from the site were measured, then compiled in Microsoft Excel®, and statistically analyzed. Pipe stem breakage experiments were conducted on historic reproduction clay pipes to compare to the data of the site. The stem fragments from the experiments were then measured, compiled in Microsoft Access®, and statistically analyzed. The results of the statistical analysis from the Mount Pleasant pipes and the experimental pipes conclude that while pipe stems are liable to accidental breaking, the intentional breaking of stem fragments can be identified by lip and corresponding lip scar breakage patterns which are present in the Mount Pleasant pipe assemblage.

INTRODUCTION

The pipe is not just an instrument used for smoking; it is a form of art and a symbol of solace in the commonplace. It is unknown who is responsible for making the first clay tobacco pipe, but after tobacco was first introduced to England in the mid-sixteenth century, the smoking-pipe industry rapidly developed by the early seventeenth century. Pipes of white clay became a fashionable item in high demand to satisfy men, women and children in the art and pleasure of "tobacco drinking" as it was called then (Ayto 1994, Fairholt 1968). White clay pipes were in fact so common, that archaeological sites in both England and the United States have produced these fragments by the thousands (Deetz 1977).

Early historical archaeologists contended that the reason for the recovery of so many stem fragments from sites is because it was custom for smokers to share pipes. Each smoker would break a piece off the stem after it was smoked in order to mitigate the unhygienic effects of the practice, and to provide a clean smoke for the next smoker. These theories have been discredited by some archaeologists who have made the argument that breaking off stem fragments would defeat the purpose of pipes with tapered mouthpieces, or that smoking from a fractured, jagged-end would not have been preferable (Hume 1969). Theorists argue that the prevalence of stem fragments on colonial sites is then due to the pipes' long-stemmed and fragile manufacture; so when dropped or knocked, then broke into several pieces. These interpretations may provide logical insight as to how smokers in the late eighteenth and early nineteenth centuries might have practiced their smoking habits, but without direct historical accounts of these smoking practices, these hypotheses need to be supported by archaeological evidence and scientific study.

The chronological dating of pipes recovered from archaeological sites, have been the focus of attention in order to date sites. Adrian Oswald (1975) conducted the first study in 1951 in which he dated pipes by the basis of bowl shape and identified makers' marks. The outcome was that he developed the theory that bowl typology was dependent on the individual molds that pipe makers used in manufacture. More recent attention has been paid to the dating of pipe stems, such as J.C. Harrington's study in 1954 in which he discovered a system of dating by measuring the diameter of the borehole of the stem. This system is the basis of his theory that the older the pipe, the larger the bore diameter of the stem. However, this is valid only until the end of the eighteenth century (Omwake 1965, Oswald 1967). Lewis Binford (1962) furthered Harrington's dating system by creating a formula to obtain an average date of site occupation by the size of the stems' boreholes. While it is helpful to date sites and pipes by pipe bowl typology, makers' marks, and stem bore analysis; these studies do not test how the pipes were broken.

This research paper aims to understand how stem fragments are broken, by identifying if there are certain breakage patterns that correlate with specific behaviors of pipe disposal and what those patterns may be. More specifically, by testing if the occupants at the Mount Pleasant Site were intentionally breaking stem fragments off of the pipes or if the pipes broke accidentally, there will be different: 1) Lengths of stem fragments; 2) Quantities of stem fragments; and, 3) Observable patterns of stem breakage. The statistical data of stem fragments from the Mount Pleasant Site were first statistically compiled and then compared to the systematic breaking of 61 historic reproduction pipes in two experiments. The results of this study will provide a model for pipe disposal patterns and will offer insight to the proposals of the smoking practices that consumed late eighteenth century society.

PROJECT HISTORY/BACKGROUND INFORMATION

Mount Pleasant Site Background Information

The 1999 field investigation for the Route 9 Highway Project uncovered a rural homestead, the Mount Pleasant Site, in Jefferson County, West Virginia (Figure 1). The federal undertaking for the building of a highway from Martinsburg to Charlestown involved a Phase I archaeological survey in compliance with Section 106 of the National Historic Preservation Act. First identified in a Phase I survey by shovel test probes, a Phase II recovery was recommended to further expose the Mount Pleasant Site. The site is located in an upland setting on a low rise surrounded by grasslands and slightly rolling hills (McAndrews et al. 2003). The Mount Pleasant Site is within ten miles of historic Shepherdstown, Harpers Ferry and Charles Town on the Eastern Panhandle of West Virginia.

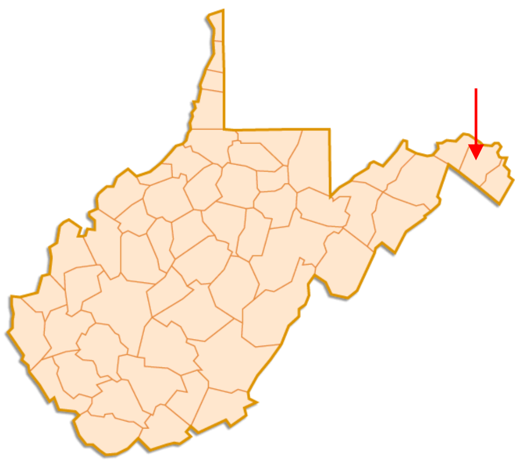


Figure 1. Location of the Mount Pleasant Site in Jefferson County

The rich farmland of the region between the Shenandoah and Potomac River Valleys provided for the gentleman farming tradition that developed among the rural homesteads in the late eighteenth and early nineteenth centuries (McAndrews et al. 2003). The archaeological site is 200 meters southeast of a stone house that dates to the early nineteenth century and still stands on the property today. While the Mount Pleasant Site has a long line of ownership history, the individuals who could have occupied the site can be identified: Moses Tullis and his family who occupied and farmed the estate from 1762 until his death in 1777, Mary Elizabeth Tullis who continued to occupy the site until 1796 with her children and new husband, and Benjamin Wiltshire and his family who served as an overseer for the property's owner Charles Yates sometime after 1787 until about 1816.

The excavation at the site included 172 test units, each measuring 1 x 1m (3.3 x 3.3ft). The historic artifact assemblage recovered from the Phase I and expanded Phase II excavations includes over 35,000 domestic artifacts that date between the 1770s and 1830s (McAndrews et al. 2003). Over 567 English clay pipe fragments made out of ball clay, a variety of kaolinite that is light to white in color with a fine finish, and is high in plasticity (Industrial Minerals Association-North America 2008), were also recovered. Relief-molded designs on the pipe fragments include embossed and incised patterns on the bowls and stems including banded, floral, geometric, stars, dots or combinations of these patterns (McAndrews et al. 2003).

Origins of Tobacco, Smoking and Pipes

In all of its various forms and involving many different groups of people throughout the distant past, smoking, chewing, and the snuffing of tobacco has always been practiced by the natives of the Western Hemisphere for many centuries. In North America, smoking may go back at least 3,000 years before the Europeans began colonizing. Therefore, it is important to note that the first Europeans in North America did not actually "discover" smoking, but were the first Europeans to see tobacco and to remember smoking. Native Americans were the first to grow and utilize tobacco for medicinal, ceremonial, and leisure purposes. They found that the perennial plant was a powerful narcotic disguised by its glossy blue-green leaves and unique flowers that can grow between three and fifteen feet high (Dunhill 1961, Fairholt 1968, Fisher 1939). .

The first English smokers were colonists that established the first colonies in Virginia and learned to use tobacco and smoke it by means of a pipe from the Native Americans (Fisher 1939). They found the native Indians of North America cultivated and smoked because tobacco was a gift from the Great Spirit (Corti 1931, Ehwa 1974, Fairholt 1968, West 1934). The colonists also noticed that they supplemented their diet and cured illnesses and injuries with smoking tobacco from a pipe. But furthermore, in deciding war, concluding peace, under religious circumstances whether public or private, these deliberations took place through the passage of the "pipe of peace" (Fairholt 1939, Fisher 1939, Dunhill 1961, West 1934). These ceremonies involved the transfer of the sacred pipe from one individual to another. Ornamented with eagle's feathers these pipes were only allowed to be used for these special occasions. Each individual would then draw a breath of smoke thereby sanctifying the ceremony. The act and the pipe itself were regarded as the "traditional sign of friendship, hospitality, and peace" (Dunhill 1961:5). Under ordinary circumstances, a native Indian would always keep their own personal pipe on them as a "constant companion through life." Through it, he would "pledge his friends and find meditative comforts" (Fairholt 1939:42).

The more the English sailors and colonists experienced these smoking practices among the native Indians, the more they came to regard the act of smoking as a pleasurable experience, and the tobacco plant, a substitute for food and drink (Fisher 1939). Smoking did not become popularized until sailors and sea captains such as Sir John Hawkins, Sir Francis Drake, Captain Philip Amadas, Captain Arthur Barlowe, Sir Walter Raleigh and all those in Ralph Lane's company, brought the practice back with them from North America between the 1560s and 1580s, (Dunhill 1961, Ehwa 1974, Fairholt 1968, Fisher 1939, Spence 1941). Upon their return to England, the colonists and sailors would then teach the pleasurable smoking habit they had learned (Corti 1931).

In the "New World," British colonists began raising the native tobacco plant *Nicotiana rustica* that had been taught to them to make small profits on the tobacco trade with England. But after John Rolfe and the original settlers of Jamestown introduced *Nicotiana tabacum* from the West Indies in 1612, it was an instant success and soon smoking became a commodity, and tobacco, a form of currency (Ehwa 1974).

Prohibition of Smoking

Despite the popularity of smoking among British colonists, smoking in its earliest years in England faced widespread opposition because some insisted that it was a barbarous, dirty, social habit that caused diseases (Dunhill 1961). King James I was one like many other pamphleteers, whom wrote ardently about how he viewed his kingdom as being corrupted by tobacco: "…a custome lothsome to the eye, hatefull to the Nose, harmefull to the braine, daungerous to the Lungs, and in the blacke stinking fume thereof," (1604). After he wrote *Counterblaste to Tobacco*, he strictly prohibited the cultivation of the plant in England, in the Edict of 1621, and also became the first to impose a tax on it. Before the edict and taxes were established, the price of tobacco had been affordable to all economic levels of European society. Whether rich or poor, the people sought out apothecaries' shops, grocers' shops, chandlers' shops, taverns, wine, ale-houses and anywhere tobacco was vendible (Fairholt 1968). But after these events, mostly only the upper strata of society could afford to smoke. The increased cost of tobacco still did not prevent the rising popularity of smoking. By the end of the seventeenth century, William III came to power that condoned smoking, and as a result, the practice became acceptable. As he traveled England in 1697, he noticed that the use of tobacco actually made the men and women of his country "thoughtful" and "melancholy" (Fairholt 1968:125). Alfred Forrester wrote of this quality men take on when they smoke a pipe of tobacco as "the man who smokes is considered equal to any man who smokes, and the proud Hidalgo, still preserving all his dignity promptly proffers the tip of his best" (1947:60).

It was not until after the shift in attitude about the character of those who smoked, that the price of Colonial tobacco gradually decreased and the number of smokers in England grew (Fisher 1939). Pipes then became a popular commodity as a result of how inexpensive they were, around two shillings a gross in 1709 (Hume 1969). Studies show that by the mid-seventeenth century, changing prices, the more availability of affordable goods, and increased earnings from multiple jobs made early consumerism of tobacco paraphernalia possible (Fox 2002). According to Ivor Nöel Hume (1969), this made pipes available to all economic levels of society. Those in the lower classes could now take part in the luxury consumption that for the most part had been a privilege for those in the upper classes. Finally, the English and British colonists of both sexes, all ages, and classes could be smokers (Fisher 1939:73).

The early seventeenth century was when the popularity of the practice was in full swing and by the commencement of the seventeenth century; smoking was at its golden age. Smoking and therefore, pipes, became a valuable commodity to the Europeans and British colonists for four reasons. First, they found tobacco and smoking absolutely necessary to maintain their health. Second, they found smoking to be a means of religious and leisurely meditation as it helped to one to relax. Third, they found the pipe to be aesthetically pleasing, and lastly, it became the fashionable thing to do (Fairholt 1968:118). Despite the initial opposition and the prohibition of the practice in England, Virginian tobacco was a major import to European countries (Dunhill 1961). By 1614, seven thousand shops in London were selling colonial tobacco (Ehwa 1974); by 1640, over a million and a quarter pounds of tobacco were being exported from Jamestown, Virginia every year (Fox 2002). And by the end of the sixteenth century, smoking and tobacco use spread throughout all of Europe and British America (Ehwa 1974).

The Art of Smoking and Clay Pipes

Smoking had become art as the common folk smoked plain clay pipes and the elites puffed away at their elaborately carved and decorated clays. Sailors always kept themselves supplied with it on their voyages; soldiers liked it as they kept guard all day and night; scholars, writers, farmers, porters and all laboring men desired a smoke because not only did they say it "refreshed" them, but that they were so addicted to it that they would rather part with food than to part with their tobacco (Fairholt 1968). Even the poorest man could not part with his tobacco and were perfectly content with their makeshift walnut shell and straw stem pipe (Dunhill 1961, Spence 1941). Smoking had been termed "drinking tobacco" or the "dry drink" during this period, and as it became an important activity for every gentlemen to accomplish along with "dancing, riding, hunting and card-playing," a gentlemen had to smoke with a certain grace (Dunhill 1961, Fairholt 1968, Fisher 1939, Goldring 1973). For those who could afford it, men would pay a tobacco tutor to teach them. Men would spend hours practicing the art of smoking, indulging in "the contemplative man's recreation," and acquiring the "gentlemen-like smell" (Fairholt 1968, Gilman and Xun 2004, Goldring 1973). This allowed for new modes of interaction to take place such as in coffee houses, taverns and clubs or wherever tobacco was sold (Fisher 1939).

Most public houses would keep a tobacco-box on the table and if the smoker paid the innkeeper, he could fill his pipe (Fairholt 1968, Fisher 1939). Iron holders were kept near the hearth to clean the smokers' pipes from the heat of the fire, as well as a tinder box containing materials to light a fire were kept on the shelves of public houses until about the mid-nineteenth century (Dunhill 1961). No matter where a smoker was, at home, on the street, or at the theater, a smoker would practice the proper technique to exhale the smoke through their nostrils, blow rings and invent new smokers' tricks like: *The Ring*, *The Whiffe*, *The Gulp*, *The Retention* (Dunhill 1961:10), *The Cuban Ebolition*, *The Euripus*, or *Receit Reciprocall* (Ehwa 1974). At all times of day a 'tobacconist' would carry a complete smokers' kit—a wooden, ivory, or metal tobacco-box that contained up to a pound of tobacco, a pair of silver or ember tongs for lighting his pipe, a knife to shred the tobacco, a small scoop, and a tobacco stopper or rammer for pressing the dried leaves firmly into his pipe bowl (Dunhill 1961, Fisher 1939, Goldring 1973). It was normal for Englishmen to greet one another by asking "will you take a pipe of tobacco?" (Fairholt 1968:90). After a time, women also became proficient smokers indulging in a pipe in a "lady-like" manner (Fairholt 1968:69). Some households would have the table set with half a dozen pipes and tobacco after dinner was finished. It was customary for children in England and France to be sent off to school with a small pouch of tobacco, their books, and their very own smokers' kit in their satchels. Mothers would take care filling their tobacco pouches every morning as this was their breakfast (Liebaert and Maya 1994, Mann and Rafferty 2004). Teachers at school would then "make sure at the accustomed time to instruct their smoking pupils the proper techniques of the habit and maintenance of the pipe" (Ehwa 1974, Fairholt 1968). Some smokers would fall asleep at night with pipes in their mouths and others would "awake during the night to light their pipe" (Fairholt 1968:117).

Clay Pipe Manufacture

The English copied not only the habit of smoking but the means of smoking from a device "formed like a little ladell" (Spence 1941:45). Many of the Indian pipes that the English came into contact with were the large elaborate pipes of the ceremonies different Native American groups held for religious and peace-making purposes. But not all of the pipes were ceremonial, in fact, large quantities of pipes have been found in burial mounds of all sizes and materials; from stone or pottery, and of the simple tube, elbow, monitor, platform, or effigy pipes. Of all the pipes, the English showed particular interest in the small personal pipes for ordinary use that would require smaller amounts of tobacco that proved to be an expensive luxury in England. Made out of stone or pottery, and anywhere from two to six inches long (Fisher 1939), the colonists and sailors would take back to England their small pipes given to them by the Indians which served as the prototype for the first English clays that were manufactured as early as 1570 (Hume 1969). Throughout the seventeenth century, the leading exporters of clay pipes included the English, French and Dutch.

The first manufactured pipes in England were made out of silver and iron (Spence 1941), but the preferred material by the late sixteenth century was a white, plastic-clay known as *ball clay*. It was locally acquired in the United Kingdom from Purbeck in Dorsetshire, Staffordshire, Cornwall, Dorset, or Shropshire in Devon (Ayto 1994, Dunhill 1961, Fairholt 1968, Oswald 1975). Pipes were made either by hand or in molds which involved considerable handwork, and finishing. After the acquisition of the clay, it was then pounded with a wooden rammer, soaked, and then mixed with water. To acquire a consistency to that of putty (Goldring 1973), the mix was then wedged or passed through a *pugmill* (Dunhill 1961). Another in the process would then pull, twist, roll, thumb, knead out, and divide the clay by hand into portions large enough for a pipe of the required various size and shape (Dunhill 1961, Fairholt 1968). He would shape the clay into a long-tailed lump. The next artisan, the molder, would fit the lump into a mold that may have had decorations. They would then take a steel-wire and push it down the center of the clay through the length of the pipe (Fairholt 1968). When the stem was short, a fairly large hole could be made by using a thick wire, but when the stems became longer and the wire had further to travel, a thinner wire was needed. This is the theory, though it is possible to find wires of differing thickness in use in the same period by the same maker (Hume 1969). An iron hand-stopper to shape the bowl was then inserted into the mold (Ayto 1994, Dunhill 1961). After the bore hole had been made, the mold was placed in a press where two iron plates would squeeze out the excess clay. The mold was then opened and the partly-dried pipe was passed on to the trimmer. Using a sharp steel instrument, excess clay was cut-away from the junction of the mold, the mouthpiece, and the rest of the pipe, including at the bowl after which was then neatly shaped. At this point, sometimes the trade stamp was impressed (Dunhill 1961, Fairholt 1968). After, they would blow down the stem to make sure the stem hole was unobstructed; the pipe was then laid on a frame or a *sagger*, which is an earthenware firing pot where it was laid to dry before it was fired in a pipe kiln for about 20 hours (Ayto 1994, Dunhill 1961, Liebaert and Maya 1994). If there had been a high demand for them, some pipe makers would tightly pack the pipes on the saggers before firing. Some pipe makers could turn out “as many pipes as 200 to 500 gross of pipes a day” (Dunhill 1961:92). Finally after the pipes had cooled, sometimes a wax was applied to the tip. Furthermore, there were hundreds, if not thousands, of pipe makers, each with his own deviations in size and shape from the other (Alexander 1967). Although the clay tobacco pipe may have been manufactured within a day, pipes were generally imported, smoked, and thrown away all within a matter of a year or two (Hume 1969).

The Evolution of Clay Tobacco Pipes

The earliest clays made as early as 1570 that were popular up until the middle of the nineteenth century, had plain barrel-shaped bowls that leaned forward, had a flat heel, and were anywhere from four to six inches in the length of the stem. These short pipes were known as a *cutty* or *nose warmer* (Goldring 1973:69). Depending on the locality of where they were found, these cutties were of the *fairy*, *Celtic*, *Cromwellian*, *Elizabethan*, *elfin* or *tavern* pipe varieties (Ayto 1994:4). With the introduction of new goods and an overwhelming interest in the practice, new refinements to the pipes were made by the beginning of the eighteenth century. Pipes were lengthened from about 10 to 14 inches although advertisements of the time referred to both short and long-stem pipes (Ayto 1994, Hume 1969). After 1640, spurs replaced the heel for three possible reasons: pipe-makers could place their initials on the spur or side of the bowl, with the new social interaction in public houses, spurs prevented the hot bowl from touching the table, or could have acted as a small handle as the bowl could heat to high temperatures (Ayto 1994, Dunhill 1961, Goldring 1976). Then when the Dutch King William II ascended the throne in 1689, he introduced the longer-stemmed and larger-bowled *aldermen*. The Dutch became unsatisfied with the small bowls the English were producing (Fairholt 1968, Fisher 1939); therefore, bowls became larger for a greater tobacco capacity, up to three-quarters of an inch. The stems of these pipes also tended to curve and were tipped with a wax glaze to prevent the porous clay from adhering to the smokers’ lips (Ayto 1994, Fisher 1939, Hume 1969). Beginning in the early eighteenth century, spurs became flat-bottomed, called *pedestal spurs*, and other pipes were produced with no spurs at all. Pipe bowls and stems also began to be molded with designs of low relief on the sides at this time (Atkinson and Oswald 1969, Spence 1941). The stem drastically lengthened again in the mid-eighteenth century from 18 to 24 inches (Ayto 1994:6). Pipes produced throughout the eighteenth century, Hume suggests, were manufactured and advertised in a variety of shapes and sizes that differed among pipe makers. In Boston, newspapers advertised “Long London tobacco pipes” in 1716 and 1742, “Boxes of short pipes” in 1761, “Long and short pipes” the next year, and “long and middling pipes” in 1763 (1969). Furthermore, Hume found an advertisement in the Boston Gazette on May 28, 1764, from a pipe maker that made “Glaz’d 18 inch London Pipes per Box” (1969). After 1815, the longer *churchwardens*, as they were coined, were made between 24 and 36 inches (Ayto 1994, Dunhill 1961, Fisher 1939). Still, others reverted to the earlier, shorter and more manageable-sized clay pipes that were around nine inches, and always remained popular up until the end of the clay pipe era in the mid-nineteenth century (Hume 1969, Liebaert and Maya 1994, Oswald 1967). One of the more important results of the refinement to the pipes was that beginning in the mid-eighteenth century; gentlemen used their pipes as conversation pieces. The extra-long pipe stems promoted socialization and were cheap to buy. By the end of the eighteenth century, the "best" clay pipes could cost eleven pence for three dozen, or a gross of Dutch clays for two shillings, also making them popular because they were easily disposable and replaceable when they broke (Dunhill 1961, Hume 1969).

Early eighteenth century was the peak of pipe smoking, but by the end of the eighteenth century, the popularity of it began to change. Because everyone, including children, clergy, merchants, and the common laborer had been puffing away at their pipes, the upper crust of society began to put away their smoking accessories and opted for their elaborate snuff-boxes. The consumption of cigars also increased by the end of the eighteenth century for two reasons: "it was daintier than a pipe, and it was sufficiently expensive so that it remained for some time a rich man's luxury" (Fisher 1939:76). Clay pipes were finally driven out of consumption by 1850 and clay pipe manufacture came to an end in 1914 (Ayto 1994). For years it was known that clay, porcelain, and meerschaum were too fragile a material, and that wood was ideal for pipes. After a French pipe-maker experimented with the root from a dwarf-oak growing in the Black Forest of Germany, the *bruyère* or *briar* as it has come to be known has become the pipe of preference even in the present-day (Fisher 1939:79)

History of Dating Clay Tobacco Pipes

Prior to studying the hole diameters of stems, the dating of tobacco pipes had relied on the evolution of the bowl form, and for pipes between the seventeenth and eighteenth centuries, this is still the most reliable guide. The first to study the evolution of the bowl in 1951 was Adrian Oswald. He discovered that as time progressed, the size of the bowl is inclined to get larger until the end of the eighteenth century, at which they get smaller, but not as small as those of the late sixteenth to mid-seventeenth centuries (Alexander 1967). The shapes of the bowl depended on the number of different molds each pipe maker possessed. The first clay tobacco pipes were made in the 1570s, so after that date, hundreds if not thousands of pipe makers were in the pipe-industry, each manufacturing different styles and sizes of pipes (Alexander 1967). However, finding bowl fragments and whole pipes prove to be more scarce than finding stem fragments on an archaeological site (Deetz 1977).

J.C. Harrington became the first to date pipes by their stem hole diameters in 1954. Edward Lenik discusses how bore diameters are measured in his article *The Step Gauge: A New Tool for Measuring Pipestem Bore Diameters*: First, a set of drill bits that contain drills in sixty-fourths increments must be obtained. Then, after a selection of a stem fragment, a drill is inserted into the bore hole. It might be necessary to try different sized drills into the hole until a snug fit into the hole is found. When the right drill has been found, the size of the drill, in sixty-fourths, is then recorded (Lenik 1971). Harrington discovered that there was a general trend where the bore hole diameters gradually decreased in size as time progresses from 1620 to 1800 (Binford 1962, Deetz 1977, Omwake 1965). The earliest pipes, dating to about 1600, had stems with bores of 9/64-inch diameter. By 1800 this diameter had decreased to 4/64-inch (Deetz 1977). Harrington noted that this change in diameter probably was due to the fact that pipe stems became longer during this period, requiring a narrower bore diameter. This transformation in turn might ultimately relate to the greater availability of tobacco, which led to larger pipe bowls and potentially longer and hotter smokes. As a result, the lengthening of the stem would have removed the hot bowl farther from the mouth, and reducing the bore hole diameter would cut down on the amount of matter transmitted through the stem to the smoker's mouth.

However, in another study that was done by Lewis Binford in 1961, he found that Harrington's method was illogical because Harrington devised the occurrence of various hole diameters by forty year time periods in a series of percentages when no archaeological sample is going to correspond to forty year time periods. From Harrington's percentages, Binford found a formula where he could substitute values from any archaeological sample into the formula, and determine the average date for the period of the sample (Binford 1962). Binford's formula is used in the latter of this paper. As a result of this formula, James Deetz (Table 1) lists the time periods that correlate to the average bore diameters in a table (1977):

Table 1. Table of Bore Diameters and Correlative Temporal Period

Diameter	Dates
9/64	1590-1620
8/64	1620-1650

7/64	1650-1680
6/64	1680-1720
5/64	1720-1750
4/64	1750-1800

In addition, Binford found that if there is a bore diameter that dominates the site, but stems with other diameters are also present, the few stems in the larger and smaller categories reflect either normal variation in bore diameter or a slightly longer time of occupation on either end of the period indicated by the majority of the stems (Deetz 1977). However, studies have been done on the methods of stem hole dating and have proved that this form of dating is unreliable. First, another result of Binford's work was that he found out that his formula breaks down towards the end of the eighteenth century and is distorted when applied to nineteenth century stems (Omwake 1965), and second, Audrey Noel Hume published her findings in 1963 that there needs to be a sample of 900 or 1000 stem fragments in order to obtain an accurate date (Alexander 1983).

In addition to the evidence of stem holes and bowl shapes, pipes may also be dated through the correct identification of makers' marks. The first studies of pipe makers and their associated makers' marks in the 1960s have been done by authors David Atkinson and Adrian Oswald (1969), whom found that the makers' mark or initial would have been molded on one side of the bowl or on the spur.

Theories of the Social Behaviors Associated with Clay Pipes

Historical archaeology is a branch of archaeology that employs the use of various forms of written accounts and documentation. This historical research then supplements archaeological information that is recovered. However, written documentation is not always available to supplement the archaeology recovered from sites. The practice of smoking clay pipes is one such case. Hundreds, up to thousands of fragments can be recovered from archaeological sites and the question remains, "why are so many pipe fragments recovered from one site?" This section of the paper will be a discussion of the main suggestions historians and archaeologists have made.

It has been argued for and against for many years that pipes were shared; passed from one smoker to the next after they took in their fill of smoke, but before passing it to the next smoker, a fragment was broken off. But before a discussion can be made on why fragments would have intentionally been broken off, a discussion of the context on why they would have shared pipes must be made.

Sharing pipes would have occurred under two circumstances: first, in a group of smokers that sat together and would have lighted a single pipe, each breaking a fragment off the stem after their smoke; or second, after a smoker finished his smoke with a pipe, would have then broken off the fragment, and laid it on the stand or rack to cool where soon after, another smoker would pick up the same pipe, light it, and smoke to their pleasure. The sharing of pipes is mentioned in many sources, but none go in depth on the reasons for it. In one such account, Barnaby Rich mentions the passing of the pipe custom in his article, *The Irish Hubbub*, that "one pipe of tobacco will suffice three or four men at once" (1618:41). F.W. Fairholt also wrote a number of accounts describing the sharing of pipes among a group of smokers (1968). Fairholt shares that in another book by Barnaby Rich called *Honestie of this Age* (1614), Rich wrote that a smoker is "(almost) never without company, that from morning till night are still taking of tobacco." In another account from a man by the name of Aubrey, he wrote in 1680 that "I have heard my grandfather say that one pipe was handed from man to man round the table" (1968:170). In the last account, as written in *Smoke: A Global History of Smoking*, a man by the name of Horatio Busion visited London in 1618. He was fascinated by the smoking ritual the city practiced: "Amongst themselves, they are in the habit of circulating toasts, passing the pipe from one to the other with much grace" (Gilman and Xun 2004). Other authors such as Corti, Dunhill, and Fisher have also mentioned the sharing of pipes in their writing.

It is important to recognize that the first Europeans to have seen this practice of sharing pipes were the British colonists and sailors who joined in on or witnessed the Native Americans pass around the pipe of peace in their ritual ceremonies. However, the context of the pipes being passed around in the native Indians' ceremonies would have been religious or ceremonial, which differs from that of the proposed context of the Europeans. As the Europeans used the pipe for secular and personal reasons, the only logical motives they would have had in sharing pipes would include, that first, sharing pipes would have been a matter of greeting one another. For example, Fairholt quotes Richard Brathwait's book entitled *The Smoaking Age*, that English gentlemen "whose first salutation to their acquaintance is, 'Will you take a pipe of tobacco?' Or to a lady was, 'Dear Lady, please you take a pipe of tobacco'" (1968:66). Second, sharing pipes would have been a bonding experience among friends or even strangers to enjoy each others' company. King James I could not even deny that the importance of tobacco was no longer as a cure, but as a means of "good fellowship," and "he that will refuse to take a pipe of Tobacco among his fellowes is accounted (as) no good company" (James I 1604). Alfred Dunhill is another notable author that mentions in *The Gentle Art of Smoking* how "clay pipes were passed from hand to hand in the so-called 'tabagies'—meeting places resembling ordinary taverns." Dunhill includes an account of a London coffeehouse in 1714 from a man by the name of "Addison":

> I was yesterday in a coffeehouse not far from the Royal Exchange, where I observed three persons in close conference over a pipe of tobacco; upon which, having filled one for my own use, I lighted it at the little wax candle that stood before them; and after having thrown in two or three whiffs amongst them, sat down and made one of the company. I need not tell my reader that lighting a man's pipe at the same candle is looked upon among brother-smokers as an overture to conversation and friendship [Dunhill 1961:17].

A third reason that smokers would have shared pipes is because they took their tobacco seriously and would have wanted their acquaintances to indulge in the "best tobacco." Such a narrative was written by a man in London named "Piscator Cotton" of his own account when he asked a man named "Viator" if he was "for the diet" of a pipe of tobacco. Viator answered that Cotton's pipe must have been good because of the smell. Cotton offered his own pipe to Viator and replied, "If a man does smoke, let him smoke good tobacco, that no extra and unnecessary offence be given to the 'weaker brethren'" (Fairholt 1968:119). The last and most logical reason smokers would have wanted to share pipes is that it would have been in their best interest to conserve pipes; whether among a group of smokers or for a number of smokers to share a single pipe that is smoked at different times. It wasn't until the mid-seventeenth century when tobacco and pipes were available to smokers of all ages and classes; so whether pipes were smoked at home or public houses, smokers would have looked for ways to still get their daily intake of tobacco smoke, but not spend more than they could afford on purchasing the necessary smoking paraphernalia. It also became a business practice for taverns to keep a supply of pipes and tobacco whether free (Spence 1941), or for their guests to purchase and could "check out" again on later visits (Jay 1935:4). And as long as the pipes as a whole remained unbroken, tavern keepers would have allowed their customers to re-use them to keep from consuming their pipe supplies too fast (Hume 1969).

Furthermore, while pipes may have seemingly been shared for cultural and economic reasons, the causes for the quantities of stem fragments recovered from archaeological sites needs to be addressed. The main theory is that pipes were shared among smokers and that in between each individuals' smoke, a part of the stem was broken off. An example of this "breaking-off-fragments-from-the-stem" phenomenon is in David Jay's *Tobacco Smoke and Taverns*. He explains that "when a tavern-keeper learned that one of his guests had finally gone to sleep," he would take the pipe from the sleeping smoker, "break off part of the stem, and restore the broken pipe to its customary place" (1935:5), either on a wall-rack or vertical cooling stand (Spence 1941).

One reason suggested by George Cooper Spence for breaking off fragments of the stem was that it was done to mitigate any unhygienic affects a smoker could contract from the previous smoker (Spence 1941). But it is highly unlikely people during the eighteenth century were concerned about contracting germs and diseases from smoking. Germs and their correspondence to disease were not discovered by Louis Pasteur until the 1860s. The second suggested reason was that stem fragments were broken off from the stems in order for the next smoker to have a clean smoke. Alfred Dunhill contends that the purity and taste of smoke deteriorates with every use so required daily maintenance and cleaning (1961). However, Ivor Noel Hume (1969) disagrees. Hume argues that breaking a piece off the stem to "give himself an unsullied mouthpiece," is "nonsense" for three reasons:

1. Pipes were carefully tapered at the mouthpiece to fit the lips, so the removal of more than two or three inches would have defeated that purpose.
2. It is extremely unlikely that a smoker would have been satisfied to smoke from a pipe with a jagged-end. And if fragments were broken off the stem, smokers would have then wanted to carefully file or ground down the end to shape a new comfortable mouthpiece.
3. The clear explanation then for the prevalence of stem fragments on colonial sites is that pipes were made with fragile material and had long stems, which made it easy to accidentally drop or knock into numerous pieces (Ehwa 1974, Hume 1969).

Two more suggested reasons for the prevalence of stem fragments on archaeological sites may also include that pipes broke due to being the objects of entertainment and are further broken down by post-depositional processes.

Clay tobacco pipes may have amused the smokers and the non-smokers as well, and as a result of this entertainment, numerous pipes were broken. Fairholt describes an account of a tavern-keeper who kept his guests entertained by taking clean tobacco pipes and after lining the mouthpieces off the edge of a table, he would blow into them, each pipe making a different pitch and creating a tune. The keeper confessed that even though he could make musical pipes, "he broke such quantities of pipes that he almost broke himself" (1968:174). Fairholt also wrote about Mahommed Caratha who performed in the 1740s a pipe-balancing act where on a slack rope, he would "fire pistols from each hand" and balance at the "same time seven tobacco pipes on a ring held in his mouth" (1968:174). A popular pastime up until 1930, was for children to blow bubbles in clay pipes which also could have resulted in the accidental breaking of pipes (Ayto 1994).

After all this, it still must be acknowledged that whether the pipes were broken intentionally or accidentally, or for whatever the reason, the pipe fragments will be affected by the numerous processes that occur in the ground after the fragments were deposited. In recounting these processes, it begins after the fragments were thrown-away in garbage pits outside the back of the home or public house; those pits would have eventually been compacted and backfilled firmly almost to a point where there would have been no evidence of a garbage midden. They would not have wanted to risk the injury of falling into a large pit in the ground when walking outside. Compacting and backfilling alone may further break the fragments down. Then, after the pits were backfilled, transformational processes began after the pipe fragments were disposed. These processes include all the conditions and events that affected the pipe fragments from the time they were deposited to the time the Mount Pleasant Site was excavated. Such processes can include: further soil deposition on top of the pits, disturbances from animal activity such as burrowing, or human activity such as plowing, as well as tree roots, erosion, extreme temperature variations and water seepage in the soil can all effect the physical characteristics of the pipe fragments.

Theories describing possible reasons why people may have desired to intentionally break stem fragments off of pipes bring to light new insights about the smoking behaviors during the clay pipe era. However, if ethnographic accounts do not exist of explanations to these smoking practices to support these theories, pursuing the question why pipe stems were broken is seemingly endless. Instead, my research approaches this problem from a *how* they broke standpoint. By investigating how the fragments could have broken and if there are characteristics about stem fragments that can be identified that determine how they were broken, this can lay the foundation to the right kind of research necessary to answer why there is an abundance of stem fragments on numerous archaeological sites.

METHODOLOGY

Mount Pleasant Site Statistical Data

During the inventory of the Mount Pleasant pipe assemblage, the presence of the large quantity of pipe fragments was observed. The process of discovering how the pipes from the Mount Pleasant Site were broken, began with collecting statistical data of the pipe assemblage. This information included: the fragment length and exterior diameters (the two ends and midpoint of the stem fragment) were measured using calipers, the bore diameters of the stem fragments were measured using drill bits in 64ths of an inch, the quantification of bowl fragments, bowl typology, the quantity of stem and bowl juncture fragments to determine the approximate *Minimum Number of Individual* (MNI) pipes within the assemblage, as well as a stem breakage typology list of observable characteristics of the fractured ends. The statistical data gathered from the Mount Pleasant Site was then compiled into Microsoft Excel®, and then compared to the statistical data gathered from two experiments that tested intentional breaking and accidental dropping.

Experiment 1: Intentional Breaking

In the first experiment 49 pipes were intentionally broken in which 24 participants received a six-inch pipe, and 25 participants received a 16-inch pipe. They were then instructed to break fragments off from only the ends of the pipe stems multiple times. Each broken fragment was numbered starting with number one at the mouthpiece to allow for easier assemblage of the pipe during analysis. To investigate if the direction of breakage would result in different stem patterns, each participant broke off the stem fragments in one of four directions and only with that same direction for the entire stem shaft. For each of the four directions, six long and short pipes were broken: 1) from a *top-down* motion pushing down from the top of the stem, 2) *bottom-up* motion pushing up from the bottom of the stem, 3) *right to left* motion (when the front of the bowl is facing you) (Figure 2), 4) *left to right* motion (when the front of the bowl is facing you).

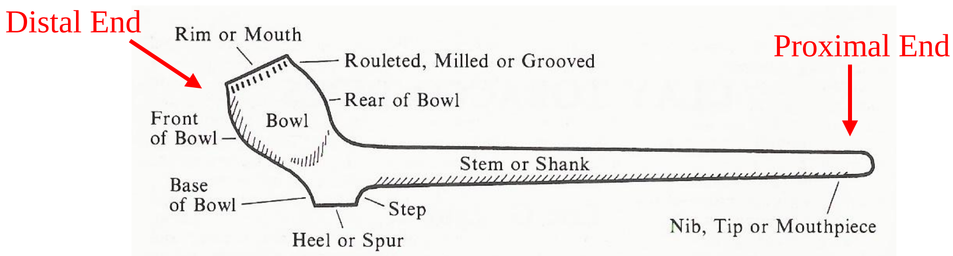


Figure 2. Labeled diagram of the parts of a clay tobacco pipe (Ayto 1994:2)

After each fragment was broken off and numbered, participants were asked to make notes on their catalog sheet including: the way in which their pipe was held, if there was a change in their holding method, the proximity of their hands and if any of the breaks were accidental. All fragments were counted, recorded, and placed in a catalog bag. During the analysis of the intentionally broken fragments, all the fragments were assembled back together using the numbers on the fragments as a guide. The fragment ends were then labeled as either *proximal* or *distal* in order to distinguish the stem ends for recording. The *proximal* end refers to the end closest to the mouthpiece, and *distal* end being the end closest to the bowl (Figure 2). The statistical data was then collected from each of the experimental pipes, and then recorded in Microsoft® Access.

Experiment 2: Accidental Dropping

In the second experiment, a participant dropped 12 pipes (six, six inch and six, 16 inch pipes) on a wood floor from the heights of three feet (table height) and five feet (bar height). To determine if how the pipe was drop would affect the stem breakage pattern, the pipes were dropped from the bowl, middle of the stem, and from the mouthpiece. After all the pipes were dropped, all the fragments were counted, recorded and placed in a catalog bag. During the analysis, each of the fragments were numbered, and the stem ends were either labeled as proximal or distal. Statistical data such as the quantity, lengths, and observable breakage patterns of the experimental pipes were then compiled in Microsoft® Access.

RESULTS

Analysis of the Mount Pleasant Site Data

Total Pipe Assemblage. The results from the inventory of the Mount Pleasant Site pipe assemblage consists of 567 total pipe fragments, and about 70 percent of those fragments are made up of stem fragments (Table 2, Figures 3 and 4). The remaining 30 percent of the assemblage is comprised of pipe bowls, and one fragment that could not be identified.

Table 2. Total Counts of Mount Pleasant Site Pipe Assemblage

	Total	*Percentage*
Bowls	171	30.2%
Stems	395	69.7%
Unidentified Fragment	1	0.2%
Total Fragments	**567**	**100.0%**

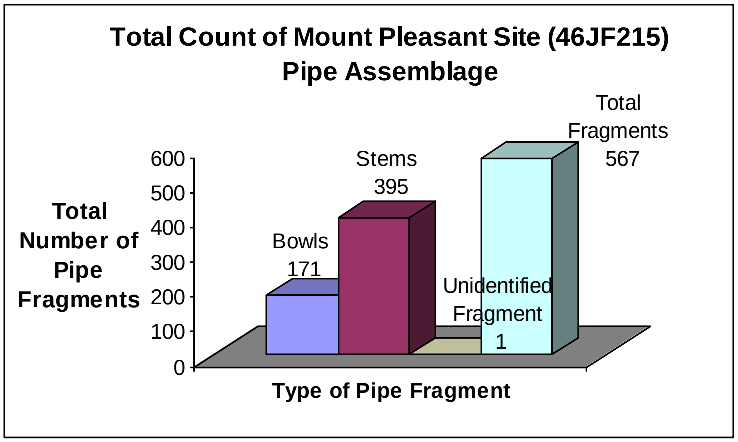


Figure 3. Total Counts of Mount Pleasant Site Pipe Assemblage

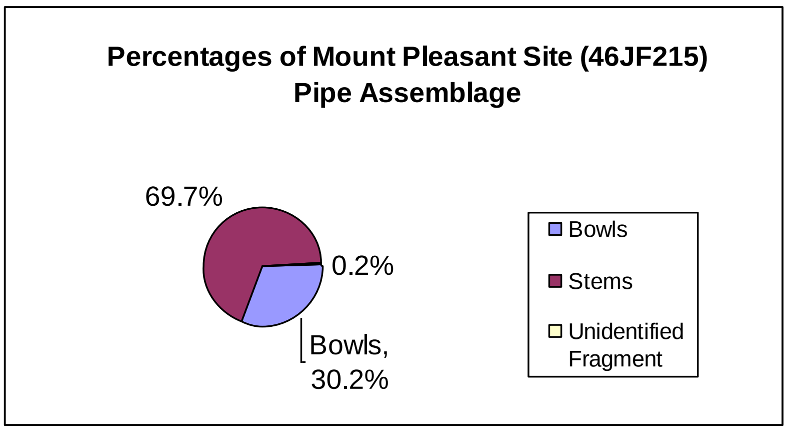


Figure 4. Percentages of Mount Pleasant Site Pipe Assemblage

Approximate Number of Pipes in the Mount Pleasant Site Assemblage. A unique element to all pipes was counted to provide an estimation of the minimum number of individual pipes in the Mount Pleasant Site pipe collection (Plate 1). Twenty-eight stem and bowl juncture fragments were counted, which suggest that the minimum possible number of pipes that had been disposed at the site were 28 pipes.

Plate 1. Stem and Bowl Juncture Fragments

Length of All Stem Fragments. The lengths of all 395 stem fragments were recorded using digital calipers in millimeters. Figure 5 illustrates that the lengths of all the stem fragments are consistent. There is a strong pattern that a majority of the stem fragments fall between the lengths of 20 and 30 mm and any length above or below that range are outliers. The results of Figure 5 also illustrate that the average length of all the fragments was 25 mm, the maximum length was 91 mm and the minimum was five millimeters (Plate 2).

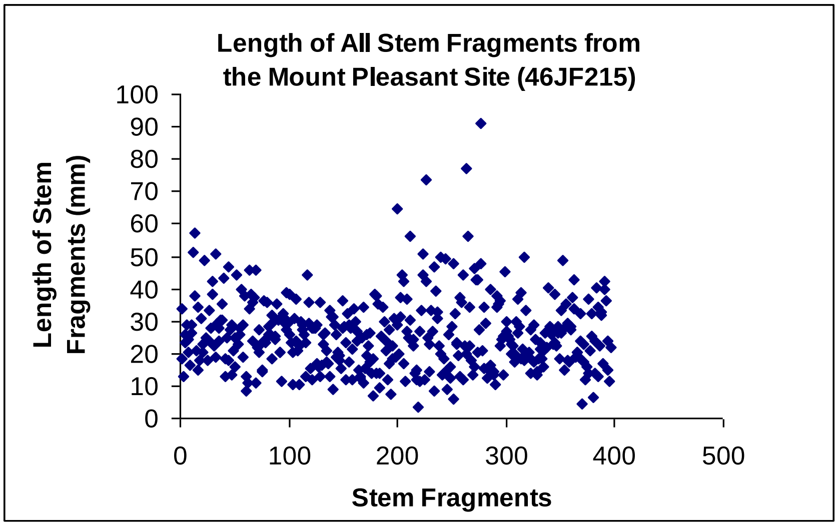


Figure 5. Length of All Stem Fragments from the Mount Pleasant Site

Plate 2. Average Length of Mount Pleasant Site Stem Fragments

The first histogram (Figure 6) shows the frequency of stem fragments by 10 mm intervals. The graph illustrates that over half of stem fragments in the Mount Pleasant pipe assemblage, or 346 fragments are between the lengths of 10 and 40 mm. The range of length that had the highest stem fragment frequency was between 20 to 30 mm at 155 fragments. The second highest range with 116 fragments was between 10 and 20 mm, and the third highest at 75 fragments was between 30 and 40 mm. Only 10 fragments were of lengths over 50 mm.

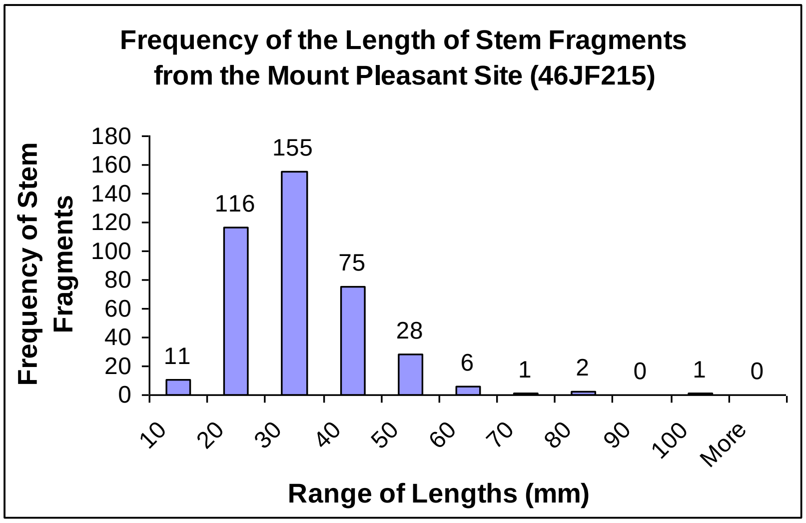


Figure 6. Histogram of Frequency of Stem Fragments at 10 mm Intervals

The second histogram (Figure 7) further breaks down the frequencies of stem fragments and ranges of lengths to five-millimeter intervals. The highest frequency at 78 fragments falls between the 25 and 30 mm range, and the second highest frequency at 77 fragments were between 20 and 25 mm.

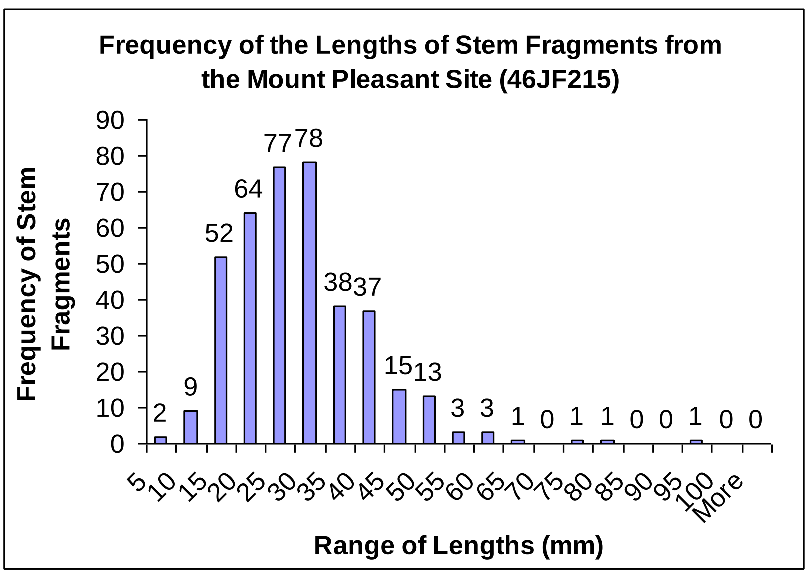


Figure 7. Histogram of Frequency of Stem Fragments at Five Millimeter Intervals

Stem Bore Analysis. Edward Lenik's methodology was applied in using drill bits that measured 64ths of an inch to measure the bore diameters of all the stem fragments. The Mount Pleasant Site pipe assemblage is comprised of pipes with stems that measure 4/64, 5/64, and 6/64 of an inch. Pipe stems that measured 5/64 of an inch had the highest total of bore measurements at 237. The 4/64 bore diameter was the second highest at 74 fragments, and 6/64 bore diameter had the lowest at 37 stem fragments. There were 50 stem fragments that did not yield stem holes, therefore those stems could not be accounted for in this analysis (Figures 8-9 and Table 3). With over half of the stem fragments measuring at 5/64, pipes manufactured with this diameter date from 1720 to 1750 (Deetz 1977). Pipes with the smaller diameter of 4/64 date from 1750 to 1800 and those pipes of the 6/64 diameter date from 1680 to 1720 (Deetz 1977). The stems with larger and smaller bore diameters can indicate that older pipes could still be acquired as well as new pipe imports could be bought, and that the occupation at the Mount Pleasant Site extended to 1800.

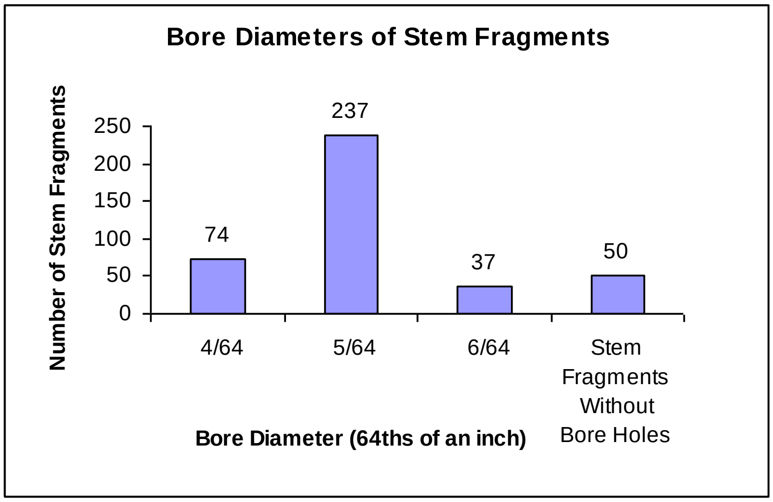


Figure 8. Bore Diameters of Stem Fragments

Table 3. Statistics of the Stem Fragment Bore Diameters

	4/64	5/64	6/64	Stem Fragments Without Bore Holes
Count	74	237	37	50
Average Length (mm)	26	28.19	26.69	
Average Length (in)	1.02	1.11	1.05	
Average Stem End Diameters (mm)	7.67	7.63	7.5	
Average Stem Fragment Midpoint Diameter (mm)	7.57	7.34	7.43	

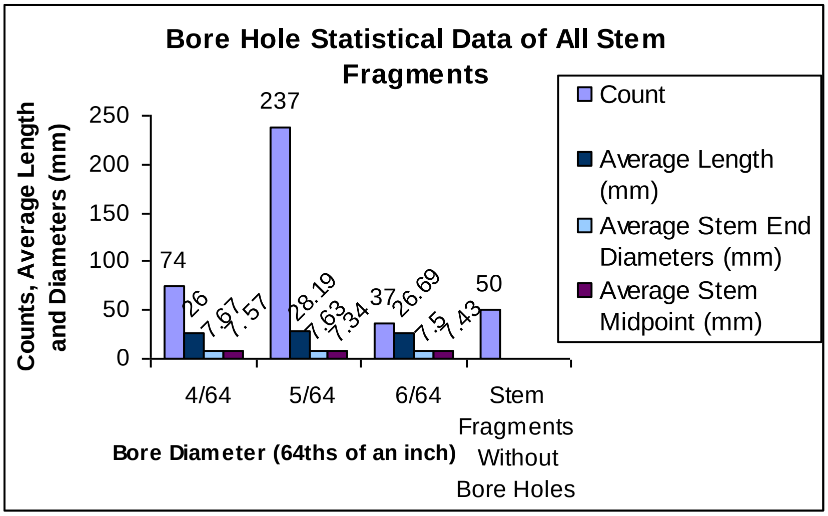


Figure 9. Statistics of the Stem Fragment Bore Diameters

Another way that the pipes can be dated is by using Lewis Binford's stem bore statistical formula that was refined in 1961 from J.C. Harrington's method. The formula expressing the relationship between the date and stem bore diameter is as follows:

$$Y = 1931.85 - 38.26\,X$$

Where Y stands for the date of the deposit and X is the average stem bore diameter expressed in 64ths of an inch. Applying the formula to the Mount Pleasant stem fragments the following results were obtained:

Diameter of Bore	Number of Stem Fragments
4/64 in.	74
5/64 in.	237
6/64 in.	37
Total	**348**

$$\text{Average bore diameter, } X = \frac{(4 \times 74) + (5 \times 237) + (6 \times 37)}{348}$$

$$X = 4.89$$

$$Y = 1931.85 - (38.26 \times 4.89) = \mathbf{1744.7586}$$

Lewis Binford's (1962) stem bore formula gives a result of the average date of occupation at the Mount Pleasant site to be 1744. However, the first occupants of the site, the Tullis family, did not acquire the land until 1762, so the formula date in this case has proven to be inaccurate. Explanations include that both Binford and Harrington did specify that these calculations diminish in accuracy towards the late eighteenth century, beginning around 1760, and the formula being total unreliable in the nineteenth century (Oswald 1975). Historical archaeologist Audrey Nöel Hume further argues that for any date of occupation to be accurate using Binford's formula, the sample needs to include at least 900 fragments (Oswald 1975). Other possible explanations includes that pipe makers used various sized wires during different periods as this can also affect dating of the stem on the basis of too small a sample or on specifying a certain date from a single stem bore, or that the occupants at the Mount Pleasant Site were simply keeping older pipes and were using them later.

Although dating the pipes by the stem bore have proven to be unreliable for this pipe assemblage, it may be possible to find a date of occupation by the general stem typology. The general conclusion from Harrington's study that the larger the diameter of the bore and stem, the older the pipe may be applied. The stems present in the pipe assemblage range from medium thick to small, and narrow in thickness which can date from 1700 to 1840 (Oswald 1975).

Bowl Typology. None of the bowl or stem fragments exhibited makers' marks. As a result, the best way to date the pipes is by their general bowl typology (Plates 3-5). There are only two complete pipe bowls in the assemblage which are similar in typology. The overall small shape of the bowls, and the bowls' thin walls suggest that those date from 1780 to 1850 according to Lynford Alexander (1967). A reversion to smaller bowls began in the late eighteenth century, as well a less projecting, or straightening to the front of the bowl briefly took place during this time. Pipes of this same general size and shape persisted into the middle of the nineteenth century (Alexander 1967). The spurs of the bowls are also a temporal indicator. Other stem and bowl juncture fragments present in the Mount Pleasant assemblage also have smaller, thin, flat spurs, perpendicular to the bowl which approximate in date from 1780-1840 (Oswald 1975). The date of occupation according to David Atkinson and Adrian Oswald's bowl description of "thin brittle bowl, flat based spur," is 1780-1820 ((1969) Plates 4 and 5). Other partial bowl fragments in the Mount Pleasant assemblage are different in typology. A stem and bowl juncture present in the assemblage is much smaller and the bowl is more bulbous as compared to the previously mentioned bowls (Plate 5). The stem is also slightly thicker and the spur projects forward. Although the spur is small, thin, and flat which is distinctive of the late eighteenth century, the spur is not perpendicular to the bowl. According to a study done on the *Clay Pipes from Chester,* by Peter Davey and Jane Rutter, this stem and bowl juncture dates from 1640-1680 (1980). More numerous in the Mount Pleasant assemblage are fragments of upright narrow bowls with medium to thick walls and thick stems (Plates 3 and 5). These bowls generally do not have spurs and date from 1730-1760 (Oswald 1975).

Plates 3-5. Bowl Typology

Stem Breakage Typology. In order to compare the observable characteristics of stem breakage for the two experiments, a list of the patterns of stem breakage were compiled from observations during the analysis of the Mount Pleasant Site pipe stems (Table 4). The list of visible stem end breakage patterns from the Mount Pleasant Site pipe assemblage is as follows:

Table 4. Typology List of Break Patterns from the Mount Pleasant Pipe Assemblage

Edge Patterns	Core Patterns
Rounded, even edges	Swirl pattern
Rounded, jagged edges	Layered, ridged pattern
Sharp, even edges	Smooth pattern
Sharp, jagged edges	Rough pattern
Whole Fragment	**Angle of Fracture**
Whole fragment	Slanted
Portion(s) of stem missing	Vertical

Experiment 1: Intentional Breaking

In the first experiment, 49 pipes were intentionally broken which resulted in 435 stem fragments. Participants commented that it was harder to break the six inch pipe than the 16-inch pipe and that the fragments were easier to break in the beginning of the stem than closer to the bowl. The rest of this section breaks down the results from *Experiment 1* by the results of testing for the hypotheses.

Length of All Stem Fragments. The length of the stem fragments from intentional breaking resulted in consistent lengths. Figure 10 illustrates that the major cluster of lengths from the intentionally broken fragments is similar to the cluster of lengths of fragments from the Mount Pleasant Site although the pattern is not as strong as there is slightly more length variation. The histogram in Figure 11 further explains this similarity between the lengths of fragments from the Mount Pleasant Site and *Experiment 1*. Although more stem fragments had varied lengths than the fragments from the Mount Pleasant Site, 41 percent of all of the stem fragments from *Experiment 1*, or 179 fragments fell between the same length range of 20 and 30 mm.

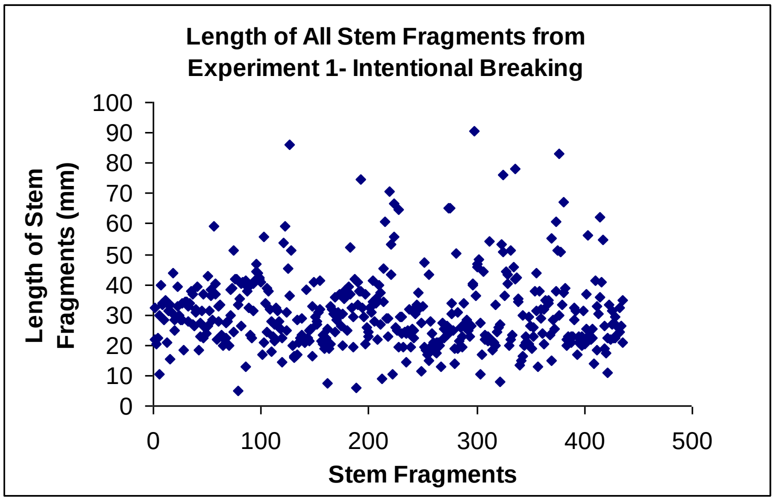


Figure 10. Length of All Stem Fragments from Experiment 1

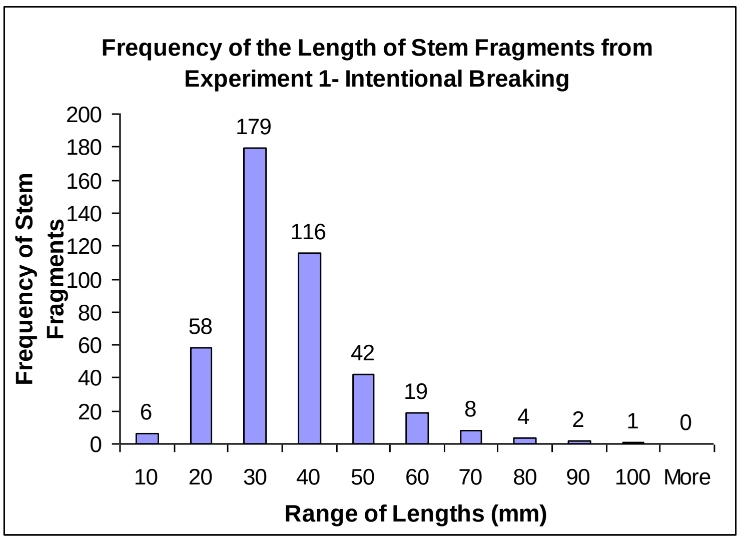


Figure 11. Histogram of the Frequency of Lengths of Stem Fragments from Experiment 1

Both the six inch pipes and the 16 inch pipes produced fragments that averaged in length to about 30 mm, however, the 16 inch pipes yielded a larger amount of shorter fragments overall. Generally, participants commented they could intentionally break shorter or longer fragments although a number of participants also commented that breaking shorter fragments took a lot more strength and pressure to do than to break longer fragments. The resulting length of the fragment appears to be associated with four variables: 1) How the pipe was held, 2) The amount of pressure the participant applied, 3) Where the pressure was applied, and 4) The proximity of their hands.

1. How the Pipe was Held. Based on the first experiment, ten different methods of breakage were identified. Of the 10 breakage methods, four methods made up 303, or almost 70 percent of the 435 total stem fragments (Table 5). One method, the *thumb to thumb* which involves both hands wrapped around the stem with thumbs on top and parallel to the stem, resulted in 154 breaks and the average stem length was 29 mm. The second highest frequency of stem breaks is associated with the *thumb on top, parallel to stem* method in which the thumb of the breaking hand that is breaking off the end of the fragment is placed parallel to the stem. This method had an average length of 40 mm. The four commonly used methods that were used to break the most stem fragments are highlighted in Table 5. The average length of stem fragments from the four methods is 31 mm. It is apparent (based on Table 5) that the way in which the pipe was held did have an effect on the length of the resulting stem fragment.

Table 5. The Effects of Breakage Method on Fragment Count and Average Length (mm)

Count of Fragments	Breakage Method	Fragment Length (mm)
1	Other	23.35
30	Distal Phalange of Index Finger	24.24
36	Single Hand with Thumb	29.09
55	Thumb on Top Perpendicular to Stem	29.13
154	Thumb to thumb	29.26
12	Hands Overlap	31.57
1	Index Fingers Touching	37.98
15	Thumbs on Opposite Sides of the Stem	39.44
58	Thumb on Top Parallel to Stem	40.13
8	Fist to Fist	40.26
16	One Fist	41.89

As previously mentioned, for some participants it was harder to break the stem fragments than it was for others, therefore, those that had a harder time repositioned their hands or fingers until they found a more comfortable grip where they could either break consistent lengths or found the most leverage. Some participants were forced to change their breakage method as the stem became harder to break starting between 24 and 26 cm on the 16 inch pipes. More than half of the participants changed their breakage method at least once. Those participants that found a suitable method or did not have any problems, whichever method they used, they could plan for a certain length and obtain it. However, those participants that had a harder time breaking fragments varied their breakage methods more, which also resulted in unexpected, varied lengths.

2. The Amount of Pressure Applied. Generally, the participants commented that more pressure needed to be applied to produce shorter fragments. More strength and force were needed as they progressed towards the distal end or bowl of the pipe. The breaking off of a stem fragment proved to be the most difficult to break at the stem and bowl juncture. A majority of participants found this fragment the most difficult and did not attempt to break it. For those that did, the extent to which it took to break it involved immense strength and force; one participant even had to use the table.

3. The Location of Applied Pressure. The fragments always broke the length of the stem up until where the most pressure was applied. Longer fragments generally occurred when participants left longer portions of the stem above their breaking hand or if an accidental break in their bracing hand occurred. In the accidental break, the participant did not expect the pressure from holding the stem would break a fragment from the stem. Of the 435 fragments, only 12 fragments were broken accidentally, all of which came from the 16 inch pipes. The average length of the accidentally broken fragments was 60 mm or about the width of the participants' hand.

4. Proximity of Hands. The fourth variable that affected the length of the fragment was the distance between the breaking and bracing hands. Figure 12 illustrates the results of the total fragments and the average length of fragments for the proximity of hands. It appears that the participants preferred a closer proximity of hands as 143 more breaks occurred when the hands were closer together than further apart. The graph also suggests that the closer together the hands were placed, the shorter the stem fragment that would result.

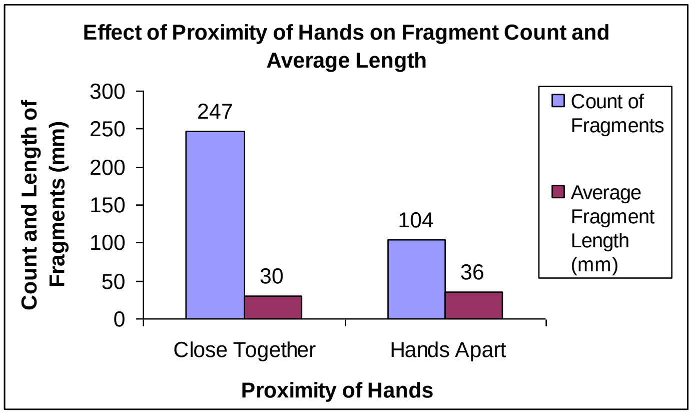


Figure 12. Effect of Proximity of Hands on Fragment Count and Average Length

Two general trends were identified: the further the hands were apart, the less control the participant had in the location the fragment was going to break, therefore there was a factor of unpredictability in the length of the resulting fragment. In contrast, the closer the hands were together, the more control the participant had in the location the stem fragment was going to break and could make a reasonable prediction in the resulting length of the stem fragment. This can be supported in that the highest frequency of fragments, 154 fragments, resulted in the average length of 29 mm, by the thumb to thumb method in which the thumbs were touching or were in close proximity (Table 5).

Quantity of Stem Fragments. The first experiment resulted in 435 fragments, 331 of those from the 16-inch pipes, and 104 fragments from the six-inch pipes. Figure 13 represents the average number of fragments that were broken for the six and 16 inch pipes. It suggests that similar to the total count of fragments in which 227 more fragments were broken from the 16 inch pipes than the six inch pipes, the average number of fragments broken from the 16 inch pipes was also significantly greater. An average of 13 fragments were broken from the 16 inch pipes in contrast to the average of four fragments broken from the six-inch pipes. One 16 inch pipe was accidentally broken and resulted in seven fragments.

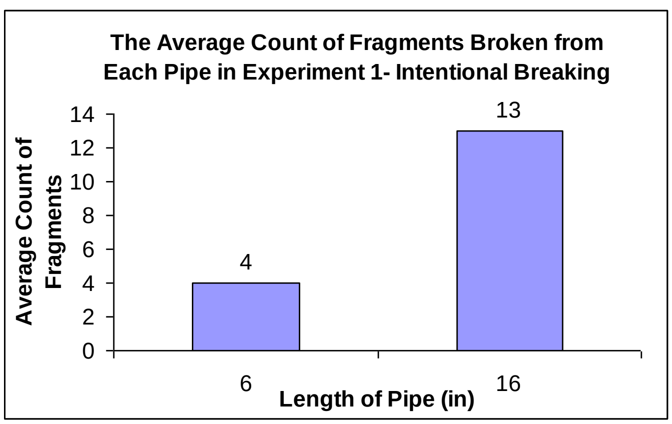


Figure 13. Average Count of Fragments from Each Pipe in Experiment 1

Observable Stem Breakage Patterns. Six characteristics of intentionally broken stem fragments were identified as a result of the first experiment: 1) Lip, 2) Lip scar, 3) Even edges, 4) Even core, 5) Divets of excess or an absence of clay near the bore hole, and 6) Flaking. Of the 435 intentionally broken fragments, 244 of those fragments resulted in a lip on the proximal end of the stem fragment, and a lip scar on the distal end (Plate 6). These patterns appear when pressure is applied in one location and is supported on the opposite side of the stem; this acts as the pivot point or fulcrum where the lip, and lip scar occur.

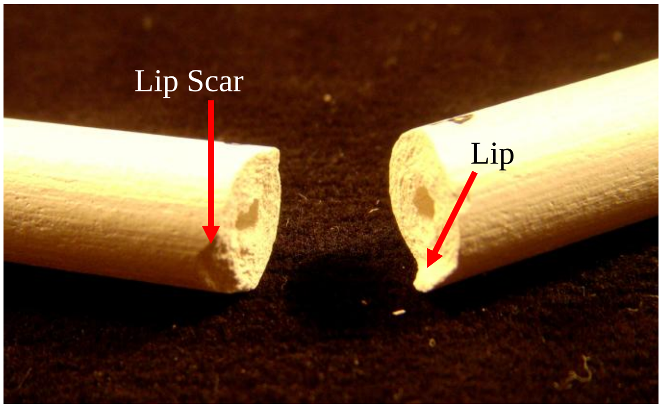


Plate 6. Lip and Lip Scar

1. Lip. A lip is a single place on the edge of a stem fragment that looks like a small, thin peak. There is a smooth, steep slope going from the core up the lip (Plate 6). The lip occurs during the break on the side of the stem that was being held where the most pressure to break the fragment was applied. A lip results in that part of the stem that absorbed all the shock from the break at the pivot point.

2. Lip Scar. A lip scar is a single place on the end of a stem fragment where shallow and gradual flaking took place from the exterior edge of the fragment going inwards on the exterior of the fragment (Plate 6). The lip scar occurs during the break on the side of the stem that is broken away from the lip at the pivot point. The lip and lip scars are the main characteristics that define an intentional break. However, there are other attributes that are typical of intentional breaking, including even edges, an even core, divets and flaking.

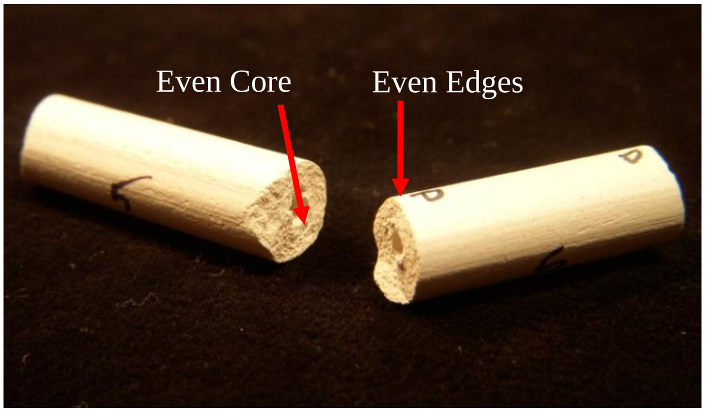


Plate 7. Even Edges and Core

3. Even Edges. With the exception of the lip and lip scar, the edge along the circumference of the stem generally has even edges (Plate 7).

4. Even Core. During the analysis of the Mount Pleasant pipes, a breakage typology was outlined including: 1) Edge pattern, 2) Whole fragment, 3) Core pattern, and 4) Angle of fracture. However, the core patterns of all the intentionally broken fragments were the same exhibiting a rough-textured core, most likely due to the clay material the historic reproduction pipes were made out of. In addition to the lip, lip scars, and even edges, all the fragments exhibited even core, in which no portions of the core were protruding (Plate 7). And concerning whole fragments, all the fragments, whether broken intentionally or accidentally, were broken in complete fragments, meaning no portions of the stem were broken off of any of the fragments; only flaking occurred.

5. Divets. Divets occur in the core next to the borehole and are either characterized as a protruding small portion of excess of clay, an *outward divet* (Plate 8*)*, or as an absence of a small portion of clay, an *inward divet* (Plate 9).

Sometimes both types of divets occurred on a break as a result of a crack in the bore hole from manufacture. These consist of a protrusion of excess clay on one side of the bore hole while the on the other side of the bore hole a portion of the clay is withdrawn (Plate 10). The same pattern appears on the end of the other corresponding stem fragment from the break, only the inward and outward divets occur on opposite sides.

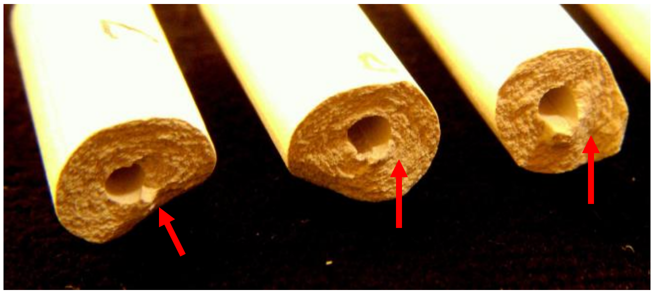


Plate 8. Outward Divets

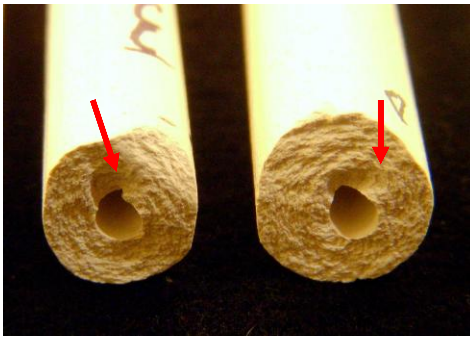


Plate 9. Inward Divets

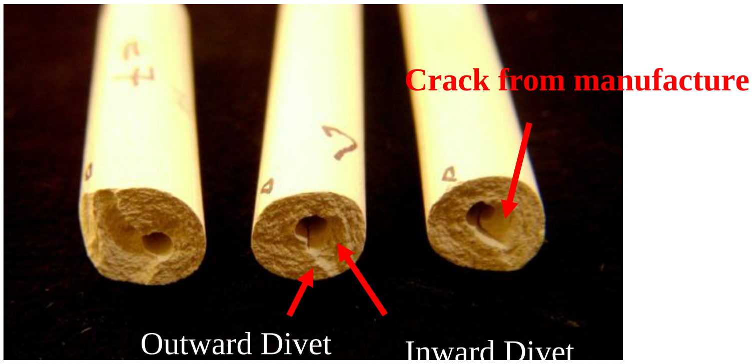


Plate 10. Both Divets

Furthermore, of all the proximal ends of stem fragments, 250 of those had divets, and of all the distal ends of stem fragments, 261 of those had divets. This statistic suggests that divets occurred from intentional breaking just as often as lip and lip scars occurred, in which, as previously stated, lip and lip scars occurred 244 times. Figure 14 further demonstrates that while outward divets occurred more often on proximal ends and inward divets on distal ends.

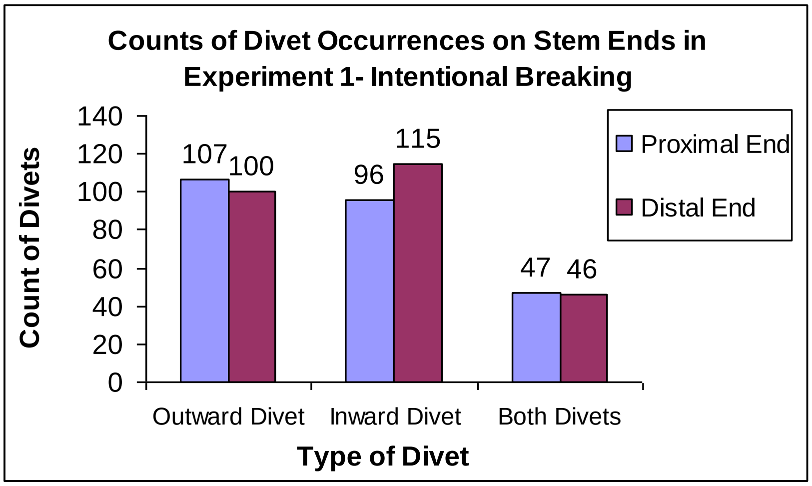


Figure 14. Count of Divet Occurrences on Stem Ends in Experiment 1

It is also important to recognize that while outward divets occurred more often on proximal ends, lips also appeared as well. It can also be suggested that while inward divets tended to occur on distal ends, lip scars were also characteristic of distal ends. It is inferred from these patterns, then, that another defining characteristic of intentional breaking are proximal ends with lips and outward divets, and distal ends with lip scars and inward divets.

6. Flaking. Flaking occurs between a lip and lip scar, above a lip scar, or a place on the edge of the stem end from a break (Plate 11). Where portions of clay are missing, intentional flaking can be identified by its shallow depth below the exterior of the fragment.

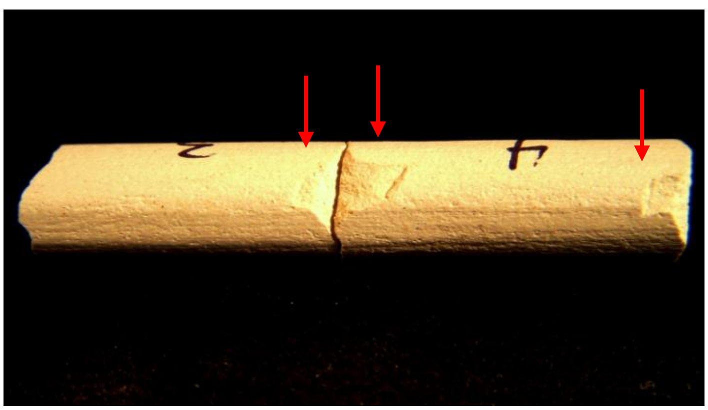


Plate 11. Flaking

The Direction Fragments were Broken. Another hypothesis that was tested was if the direction of breakage affected the breakage pattern. During the analysis of the Mount Pleasant Site pipe fragments, a sample of stems exhibited ends with pronounced and subtle rounded-edges. These rounded edges were examined under a microscope, but no evidence of intentional filing or scrape patterns was observed. As a result from the first experiment, it was determined that no matter which direction fragments were broken, no rounded-edge stems occurred. However, one participant took a fragment and ground the edge of the fragment on a wooden table; in only a few seconds, the subtle rounded-edge did in fact result. The fragment in the middle of Plate 12 illustrates the intentionally broken fragment with the grounded edge. This edge is similar to the subtle rounded edges of the two fragments from the Mount Pleasant Site on either side of the intentional fragment. The edges of the fragments in Plate 13 appear to be more receded than both the intentionally rounded fragment and the Mount Pleasant Site fragments with subtle rounded-edges.

Plate 12. Middle: Intentionally rounded fragment. On either side: Mount Pleasant Site fragments.

Plate 13. Exceedingly Withdrawn Rounded-Edges on Mount Pleasant Site Fragments

Experiment 2: Accidental Dropping

In the second experiment, 12 pipes were dropped onto a wooden floor from either three or five feet, which resulted in 71 fragments. This section also discusses the results of the second experiment according to the hypotheses that were tested.

Length of All Stem Fragments. The lengths of the stem fragments were not as consistent in length as compared to the intentionally broken stem fragments in the first experiment. The scatter plot in Figure 15 shows that there was more variation in the lengths of stem fragments as the range of length from the accidentally broken fragments were as short as 9 mm or as long as 363 mm (about 14 inches). Within this wider variation of stem lengths, the highest concentration of fragments ranged from below 10 mm to 40 mm, but fragments were evenly distributed above 50 mm (Figure 16). This indicates that the accidentally broken pipes, first, resulted in a majority of stem fragments below 40 mm but were varied in length, second, that some of those fragments were as short as 10 mm, and third, numerous fragments were 50 mm and longer.

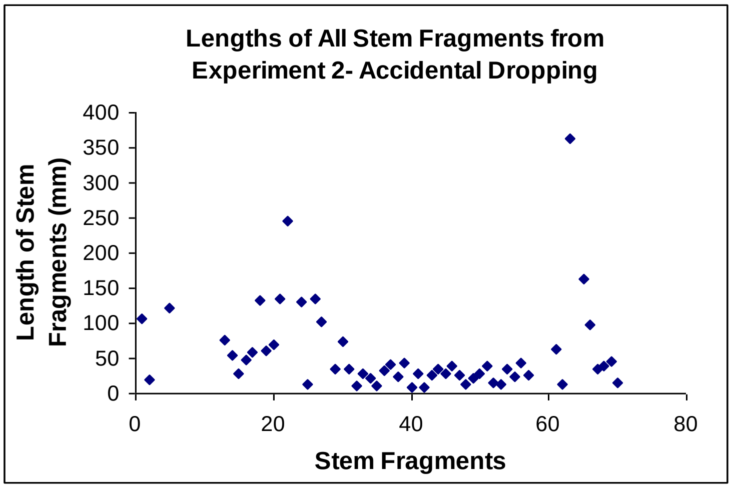


Figure 15. Lengths of All Stem Fragments from Experiment 2

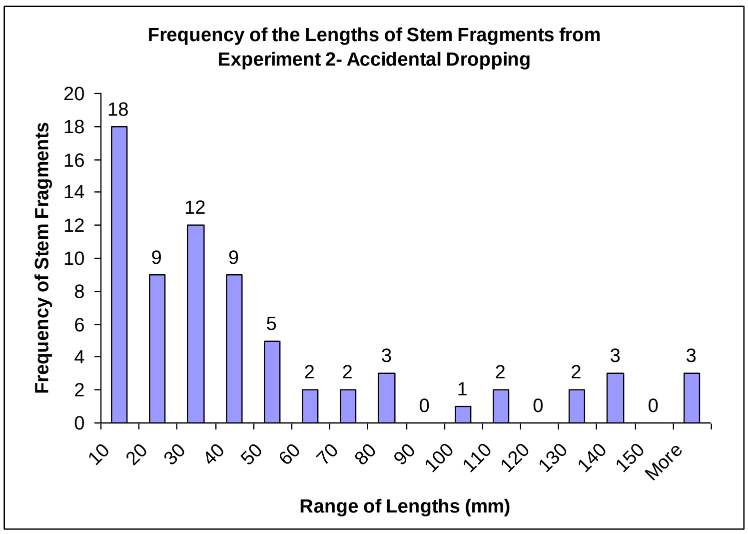


Figure 16. Frequency of the Lengths of Stem Fragments

In contrast to the wide variation in length and distribution of fragments, the length of the intentionally broken fragments was narrower in variation, ranging in length from 5 mm to 91 mm, with no stem lengths above 91 mm, and the distribution more concentrated between 20 to 30 mm. Furthermore, while the fragments broken from both the six and 16 inch pipes in the intentional experiment averaged in length to 30 mm, the lengths of the accidentally broken fragments are considerably longer. The average length of the six inch pipes were 38 mm while the fragments from the 16 inch pipes averaged in length at 47 mm.

Based on the histograms and the average lengths of the intentionally and accidentally broken fragments it can be inferred that intentionally broken fragments will generally average from 20 to 30 mm in length and that accidentally broken stem fragments, although vary in length and can also average in length from 20 to 30 mm, they tend to be 10 mm or shorter and 50 mm or longer. Although 37 more pipes were broken in *Experiment 1* than in *Experiment 2*, based on all three scatter plots of the lengths of stem fragments, the scatter plot of the intentionally broken fragments more closely resembles the scatter plot from the Mount Pleasant Site stem fragments.

Quantity of Stem Fragments. As a result of the second experiment in which accidentally dropping the pipes was tested, 71 fragments were broken. However, because 37 more pipes were broken in *Experiment 1* than *Experiment 2*, the total quantities of fragment that resulted cannot be compared to make a sound conclusion if quantities of fragments can be identified as either intentional or accidental. Under these circumstances, evaluating the average counts of broken fragments from the pipes broken in both experiments might prove to be more useful.

In the first experiment the average count of the intentionally broken pipes was four fragments for the six inch pipes, and 13 fragments for the 16 inch pipes (Figure 13). In contrast, Figure 17 illustrates that significantly less fragments were broken in the accidental experiment between the two pipe lengths. As the average number of fragments from the six-inch pipes was two fragments and the 16 inch pipes averaged to about nine fragments, this data supports that accidentally dropped pipes will result in fewer quantities of stem fragments because of the higher frequency of stem fragments with longer lengths. In addition to this, intentionally dropped pipes will result in a higher frequency of stem fragments with shorter lengths.

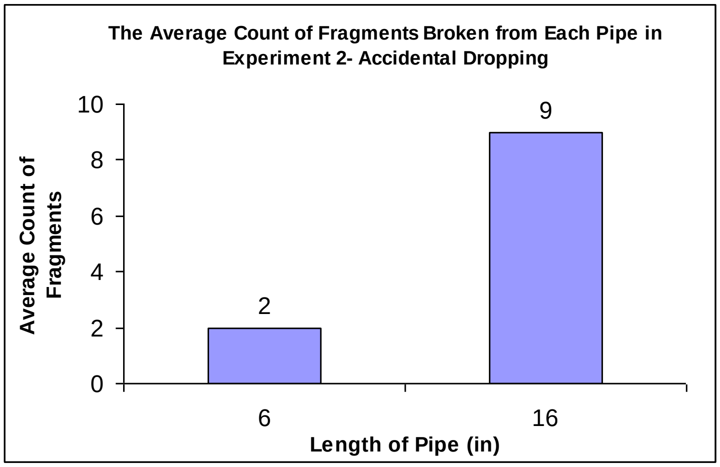


Figure 17. Average Count of Fragments from Each Pipe in Experiment 2

Observable Stem Breakage Patterns. The pipes that were accidentally dropped in the second experiment also resulted in lip and lip scars; however, the fragments had different defining characteristics of an accidental break as compared to the intentionally broken fragments. The six key accidental break patterns include: thicker, wider or longer lips, or *excessive lips*, deep lip scars sometimes with ridges, uneven edges, an uneven core, excessive flaking and bowl fragments.

1. Excessive Lips. In comparing to the intentional lips, the accidental lips were more excessive in length, width or thickness with a longer slope (Plate 14). The width of the extreme lips generally spanned the diameter of the fragment, whereas the lips of the intentional fragments only spanned a portion of the diameter. The two fragment ends on the far right in Plate 14 also show that some excessive lips were found to have ridges.

Plate 14. Excessive Lips and Excessive Lips with Ridges

2. Deep Lip Scars. Lip Scars also resulted in the second experiment, but unlike the intentional lip scars were not shallow and did not have a gradual fading effect away from the edge; accidental lip scars occurred deeper in the core and stopped abruptly at a certain point (Plate 15). Some of the lip scars also included ridges in the core which was not a characteristic of the intentional lip scars (Plate 16).

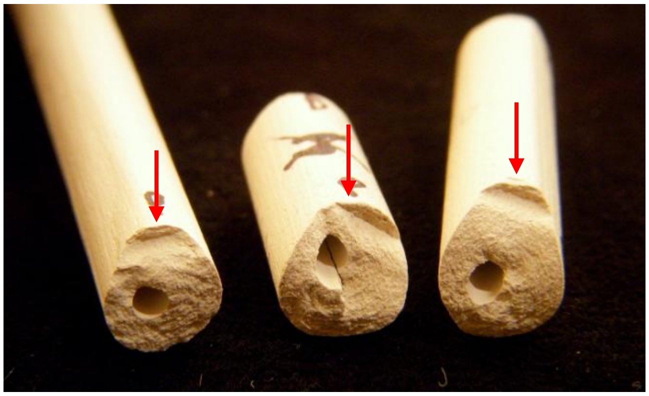


Plate 15. Deep Lip Scars

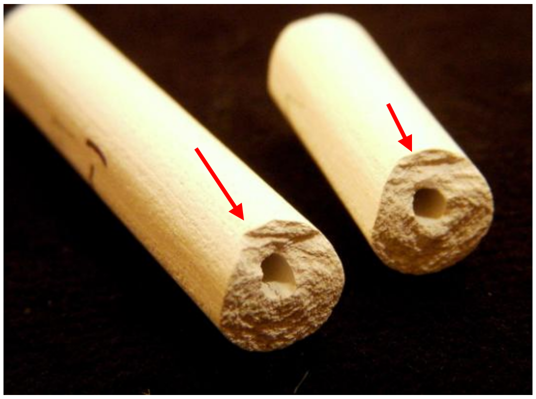


Plate 16. Lip Scars with Ridges

3. Uneven Edges. Including the lip and lip scars, some stems had jagged edges or an uneven appearance along the circumference of the stem, but most of the stem ends also tended to be even excluding the lip and lip scars.

4. Uneven Core. The cores tended to include protruding portions of clay, ridges or grooves that gave the cross-section of the core an uneven appearance (Plate 17). No divets of small projections or withdrawn portions of clay occurred. Similar to the intentional fragments, all the accidentally broken fragments were broken in complete fragments, meaning no portions of the stem were broken off of any of the fragments; only flaking occurred.

Plate 17. Uneven Core

5. Excessive Flaking. Flaking on the accidental fragments occurred deeper within the core, wider across the diameter of the stem end, and longer from the edge of the end and inwards on the exterior of the fragment (Plate 18). In addition, another common pattern to accidental breaking is that numerous fragments included ends with what appears on one edge of the fragment, as a sharp ridge or lip that spans almost the width of the fragment and a lip scar above it (Plate 19).

Plate 18. Excessive Flaking

Plate 19. Common Flaking Pattern to the Accidentally Broken Fragments

6. Bowl Fragments. One result that did not occur in the intentional breaking experiment was the occurrence of bowl fragments (Plate 20). Four pipes out of the 12 pipes total that were dropped resulted in bowl fragments with an

average of one or two bowl fragments from those bowls. Two six-inch pipes that were dropped from holding the mouthpiece resulted in bowls that shattered in half.

Plate 20. Bowl Fragments

How the Pipe is Dropped. A fourth hypothesis that was tested was if holding the pipe in a certain location would affect the breakage pattern outcome. The participant in the second experiment dropped the pipes from holding the stem, middle of the shaft and by the bowl. As previously mentioned, two six inch pipes that were dropped from holding the mouthpiece resulted in bowls that shattered. In contrast, there was one six inch pipe that was dropped from three feet by its bowl two times and both times the dropping resulted in no fragments or the whole pipe. Furthermore, of the four pipes that were dropped by holding the middle of the stem shaft, only one pipe resulted in a single bowl fragment in which it came from a 16 inch pipe. These results may indicate that the number of bowl fragments that result will depend on the amount of surface area and density of the pipe at its point of impact when it hits the floor. For example, in the case of the two pipes that resulted in shattered bowl fragments, they were dropped by their mouthpieces. This resulted in the bowl hitting the floor first, in which, not only does the bowl have a larger surface area but the bowl is hollow which means the bowl could not support the force of the impact when it hit the floor. In the case of dropping the pipe by the bowl, the mouthpiece is the location on the pipe that hits the floor first, but because the mouthpiece is densely compact, the force of impact does not affect the pipe as in the case of the six inch pipe that resulted in no fragments.

Dropped from Three and Five Feet. The final hypothesis that was tested was if the difference in height would affect the resulting breakage patterns. *Experiment 2* tested the average table height of dropping a pipe at three feet and an average bar height of five feet. Figure 18 shows that significantly more fragments, or 17 more fragments were dropped from the height of five feet than from three feet.

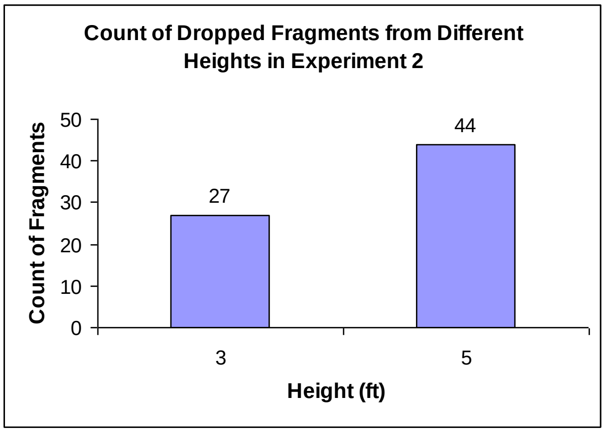


Figure 18. Count of Dropped Fragments from Different Heights in Experiment 2

By further breaking down the count of dropped fragments by pipe length, Figure 19 shows that the six inch pipes resulted in eight more fragments and the 16 inch pipes resulted in nine more fragments when dropped five feet than from three feet. From this graph it is apparent whether the pipe is six or 16 inches, more fragments will always result when a pipe is dropped from a higher height.

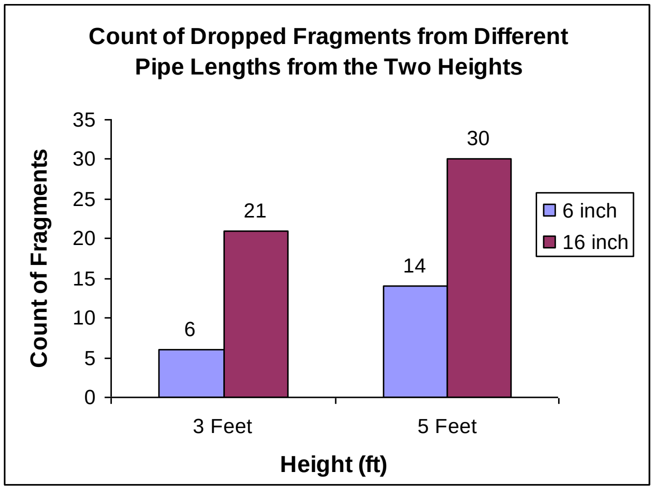


Figure 19. Count of Dropped Fragments from Different Pipe Lengths from the Two Heights

Comparison of the Experimental Data to the Mount Pleasant Site Data

After the results of the first two experiments were compiled and compared, they were then compared to the Mount Pleasant Site pipe stem assemblage. A 25 percent sample of the Mount Pleasant Site pipe stems were randomly selected by an electronic random number generator for the analysis. As a result, 99 stem fragments were chosen among the 395 total stem fragments to compare the lengths, quantities, and observable stem breakage patterns of the Mount Pleasant Site stem fragments to the experimental stem fragments. Each of the 99 fragments were then analyzed and compiled into Microsoft Access®. The results include that a total of 19 fragments out of the 99 were identified as intentionally broken, 35 fragments as accidentally broken, and 45 could not be identified. The full results of the analysis are discussed according to the hypotheses that were tested.

Length. It was determined in the analysis of the stem fragments in *Experiment 1* that intentionally broken fragments will range between 20 to 30 mm (Figure 11). In the initial statistical analysis of the entire Mount Pleasant Site stem fragment assemblage it was also determined that the average length of all the stems was 25 mm, or ranged between 20 to 30 mm (Figure 6). This also proves to be the case for the sample of 99 stem fragments as the highest frequency range was 20 to 30 mm. (Figure 20). Because of the high concentrations of the lengths of stems between 20 to 30 mm, both the histograms of the sample and the complete stem assemblage show that the Mount Pleasant Site stem fragments correlate most strongly with having been broken intentionally.

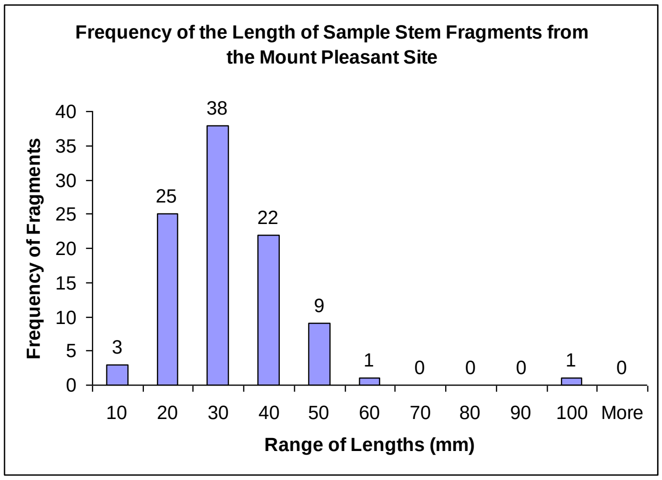


Figure 20. Histogram of Frequency of the Sample of Mount Pleasant Site Stem Fragments at 10 mm Intervals

Quantity. Although the experiments testing for intentionally and accidentally breaking stems demonstrated that intentional breaking will result in more fragments per pipe than accidental breaking, a pipe to stem fragment ratio cannot be used for the Mount Pleasant Site pipe assemblage to determine whether the intentional breaking of pipes occurred at the site or not. Although the MNI or approximate number of pipes at the site was determined to be 28 pipes, it is unknown what the exact number of pipes was, therefore a valid pipe to stem fragment ratio cannot be established.

Observable Stem Breakage Patterns. The analysis of the 99 Mount Pleasant Site stem fragments consisted of identifying the characteristics of intentional breaks, which includes small, thin, steep-sloped lips or shallow lip scars with divets, even edges and an even core, or, the distinctive accidental patterns of long or wide, thick, long-sloped lips or deep lip scars with jagged edges and an uneven core. The results of the analysis are illustrated in Figure 21 in which the percentages of the stem fragment identification are illustrated. Overall, almost half of the 99 stem fragments could not be identified. This was in large part due to six characteristics not present in either of the experiments which proved the identification of those 45 stem fragments to be difficult, and as a result, were designated as *unknown*.

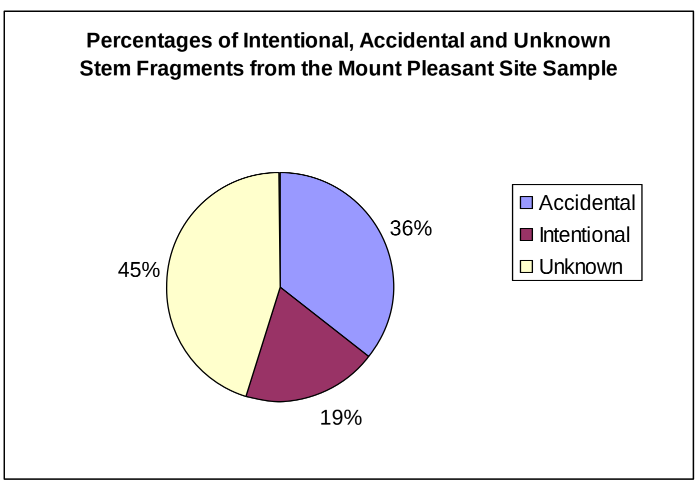


Figure 21. Percentages of Intentional, Accidental and Unknown Stem Fragments

Those *unknown* characteristics include: missing portions of cross-sections (Plate 21) and large portions of the stem (Plate 22), only halves of stem fragments (Plate 23), as well as large scrape marks (Plate 24) and rounded edges that were either subtle or exceedingly withdrawn (Plates 25-27). The following photos depict these characteristics:

Plate 21. Missing Portions of Cross-Sections

Plate 22. Large Portions of Stem Fragment Missing

Plate 23. Halves of Stem Fragments

Plate 24. Large Scrape Marks

Plate 25. Subtle Rounded-edges

Plates 26 and 27. Exceedingly Withdrawn Rounded-edges

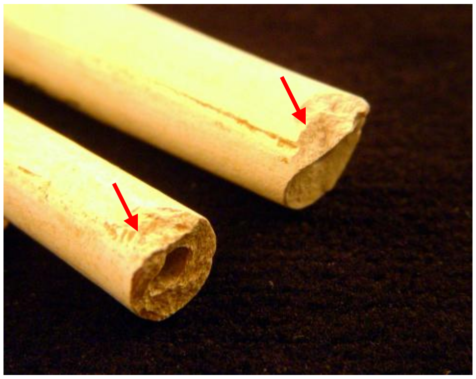
However, for the 54 Mount Pleasant Site stem fragments that could be identified, 19 stem fragments appeared to have intentional characteristics and 35 fragments were identified as accidental.

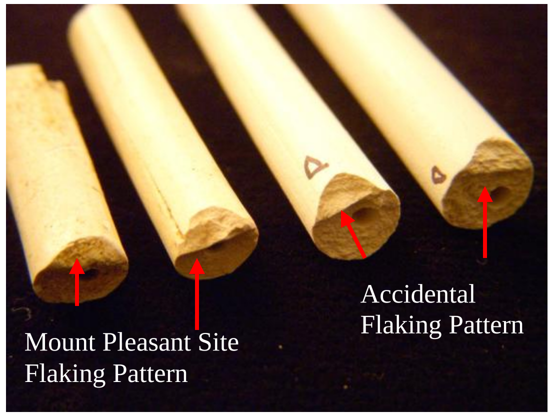
Of the 99 fragments identified, the accidentally broken stem fragments were the easiest to distinguish. The most distinctive accidental characteristics were: excessive lips in length and width (Plate 28), jagged edges and uneven cores (Plate 29), deep lip scars (Plate 30) and the common flaking pattern that is similar to the accidentally broken stem fragments, as illustrated in Plate 19, of a sharp ridge or lip with a lip scar above it (Plates 31 and 32).

Plate 28. Excessive Lips in Length and Width

Plate 29. Jagged Edges and Uneven Cores

Plate 30. Deep Lip Scars





Plates 31 and 32. Common Flaking Pattern Among Accidentally Broken Stem Fragments

Although 19 intentionally broken stem fragments were identified in the Mount Pleasant Site sample, they proved to be harder to identify than the accidentally broken stem fragments. This was large in part due to the fragments that had portions of the stem missing, or where only one-half of the fragment was present, or to the fragments with rounded edges. Some ends appeared like they may have been intentional because of the presence of an identifiable intentional characteristic, but because a segment of the stem end was missing, a valid classification could not be made. As Figure 22 illustrates, 25 percent or almost 50 ends out of the 198 stem ends could not be identified.

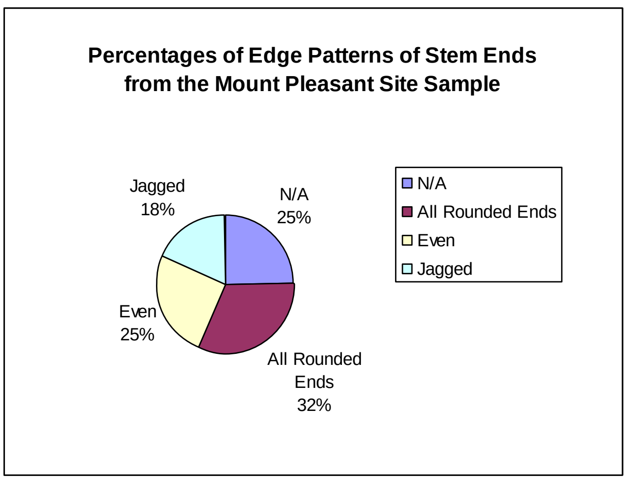


Figure 22. Percentages of Edge Patterns of Stem Ends from the Mount Pleasant Site Sample

The same was true for those stem ends with rounded edges. If a stem end was intentionally broken before it was thrown away, that behavior could not be detected on the stem ends that had exceedingly receded. Out of the 99 fragments, Figure 22 shows that 32 percent of all the stem ends were rounded. As a whole, more than half, or 57 percent of all stem ends could not be identified because of ends with missing stem portions or rounded edges.

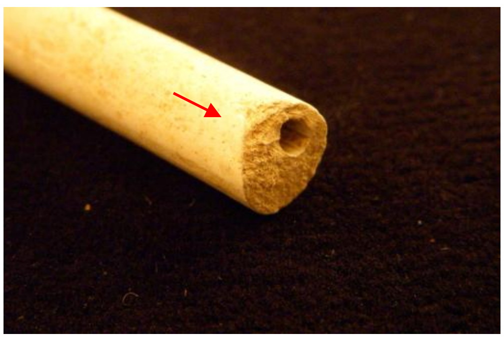
However, for the few stem fragments that were identified as intentionally broken, the smooth, thin-sloping lip, even core and edges, were recognized for 31 stem ends, three of those being on distal ends of mouthpieces, and shallow lip scars were identified for 29 stem ends (Plates 37 and 38). Plates 33 to 36 (clockwise) show a slanted lip, a subtle lip and two stem fragments with prominent lips.

Plate 33. Intentional Slanted Lip

Plate 34. Intentional Subtle Lip

Plate 35. Intentional Prominent Lip

Plate 36. Intentional Prominent Lip



Plates 37 and 38. Intentional Lip Scars

In addition to the intentional characteristics of lip and lip scars found among the sample of 99 Mount Pleasant Site stem fragments, two fragments show evidence of possible modification (Plate 39). The modified fragment on the right in Plate 39 appears to have been gnawed on and the texture is present around the circumference of the stem. The fragment on the left however, does not show evidence of gnawing but the diameter of the stem gradually, but significantly decreases about the midpoint of the fragment. This decrease in diameter and smooth texture of that portion of the stem is present around the stem's circumference.

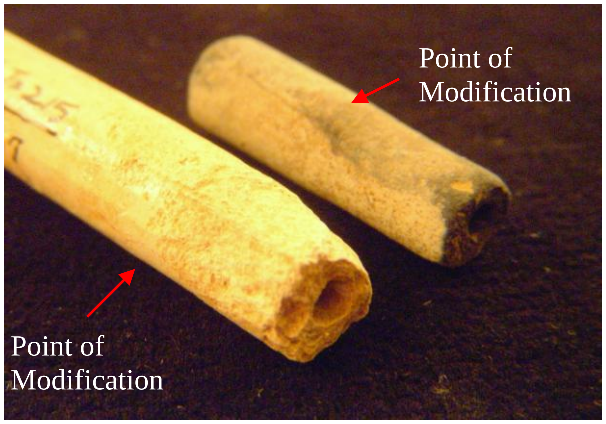


Plate 39. Possible Modified Stem Fragments

DISCUSSION

Based on the sample of the 99 Mount Pleasant Site Fragments it is evident that although the stem fragments from the site averaged in length to be the same as those fragments from the experiment that tested for intentional breaking, the breakage patterns of the stem ends indicate that the accidental breaking of pipe stems occurred more than the intentional breaking of pipe stems. From this conclusion, new ideas and possible explanations should be discussed.

It was first recognized in *Experiment 1: Intentional Breaking*, the fragility of the clay pipes. One participant had been tapping the open bowl on the palm of her hand when, all-of-a-sudden, the 16-inch pipe broke and fell onto the floor. Although only 99 stem fragments from the site were analyzed, the quantity of accidentally broken fragments compared to the intentionally broken fragments may be a good representation of the ease with which the clay pipes broke. It is probable that the pipes accidentally broke almost on a daily basis. It should also be recognized that it was discovered in *Experiment 2: Accidental Dropping*, more stem fragments always broke from the longer pipes. So if the occupants of the Mount Pleasant Site were using pipes of lengths between 12 and 24 inches that were popular during the eighteenth century and were accidentally dropping those, that could account for the large quantity of accidental fragments found at the site.

In regards to the small quantity of intentional fragments compared to the quantity of accidental fragments, the context of the site must be considered. The Mount Pleasant Site was not a place of social merriment for all the nearby locals; it was a homestead. Although historic records show two possible families may have inhabited the site, no matter the family, smoking would have been a personal, private pastime for those who smoked at home. Therefore, intentionally breaking fragments may have occurred more often in a tavern-setting than at a homestead. At home, there wouldn't have been a need to break off fragments to conserve, share pipes, or to reduce the spread of germs such as in taverns, because at home, smokers would have taken the time to maintain their pipes, enjoy them for the peace of mind they brought or to hold as small art pieces, even though the accidental breaking of pipes did happen. The designs on numerous bowl and stem fragments in the assemblage may also indicate that the occupants at the site may not have necessarily purchased them to use constantly, but to use sparingly, or only to indulge in once in a while. Based on these suggestions, a variety of sites need to be studied to determine in what contexts more or less intentional or accidental breaking occurs.

However small quantity intentional fragments were identified, the occupants at the Mount Pleasant Site were practicing this behavior. And as it is evident by the numerous accidental fragments that pipes frequently broke due to their fragility and length, no matter the type of site, the constant occurrence of broken pipes would have provided an incentive for any smoker to re-use and conserve the pipes that didn't break. This would have meant doing the proper maintenance on the pipe in between smokes—emptying the bowl of the ash, letting the pipe cool before re-use, the rotation of pipes in between each use and cleaning the bore hole with a pipe cleaner. Since pipes were manufactured in long lengths during the eighteenth century to remove the lighted hot bowl away from the face and to allow for the extended use of a single pipe, an intentional short break of the mouthpiece would not have been a bad idea to shorten the overall length of the pipe. Not only would this allow for the pipe to last longer but would have made sense to prevent from accidentally breaking the pipe stem so easily. For other smokers, conserving pipes may have meant breaking off the mouthpiece or small fragments of the stem to alleviate the bitter taste that increased with each smoke, instead of throwing away the entire pipe. For whatever the reason a smoker would try to use a pipe for as long as possible, the common, everyday smoker would not have wanted to pay more than what they could afford for something that although may have been considered a personal luxury, was also a social norm and broke very easily.

Furthermore, in order to make better distinctions as to how pipe breaks, further studies would need to be made to determine how the unknown patterns such as the deep scrapes, the missing portions of cross-sections, halves of stem fragments and rounded-edges of stems occur. As none of these patterns resulted in either experiment but made up the largest portion of fragments in the analysis of the Mount Pleasant Site sample, the effects of post-depositional processes must be studied. During the analysis of the sample, it was found that even if there were signs that intentional or accidental patterns of breakage had been present on a fragment at one point that distinction could not be made because the fragments had been affected by post-depositional processes that mitigated those patterns. The earliest the pipe fragments could have been deposited on the site was 1762 when the property had first been inhabited. And until those pipe fragments had been recovered in 1999, they were subject to around 237 years of post-deposition. Both experiments have shown the fragility of the clay used in the production of pipes, so any amount or intensity of processes that occurred in the ground surrounding the fragments could have greatly affected them making the identification of breakage patterns difficult. Therefore, studies need to be conducted on the post-depositional processes that can affect the length, quantity, and observable characteristics of the stem fragments and how those processes can be identified on the pipe fragments. Examples can include investigations on how different types of soils and how water seepage can effect the preservation of clay. And as in the case with the stems with subtle rounded edges from the Mount Pleasant Site that look similar to the stem end in which a participant ground the edge on the table (Plate 12), or the two possible modified stem fragments in Plate 39, it cannot be known for sure if those fragments really were intentionally modified until more studies have been done.

Although many more studies need to be conducted to generate more insight on the "numerous-clay-pipe-fragments-on-archaeological-sites" phenomenon, the results of this research can provide a preliminary model to interpret the behavior that result in pipe disposal patterns. If after selecting a stem fragment from a clay pipe assemblage you identify on a stem end: a small, thin, steep-sloped lip, a shallow lip scar, divets, even edges, an even core, you may have a fragment that was intentionally broken. This could especially be true if those patterns occurred on the distal end of a mouthpiece, the proximal end of a fragment that was within the stem shaft and if the fragment is between 20 to 30 mm. On the other hand, if you identify on a stem end: a long or wide, thick, long-sloped lip, or a deep lip scar with jagged edges and an uneven core, that may be a fragment that was accidentally broken. In addition, if these patterns occur on the distal end of a fragment where the proximal end looks intentionally broken, and the length of the fragment is 10 mm or shorter, or 50 mm and longer, you have better support for the fragment having been broken accidentally. Although intentionally and accidentally broken fragments can break longer or shorter according to the previously mentioned length ranges, the key to identification is to look at the breakage patterns.

CONCLUSIONS

Historic clay tobacco pipe stem fragments are often recovered from archaeological sites and the goal of this research was to understand the meaning the fragments convey. Instead of focusing the attention on why the pipe stems were broken, the research I presented in this paper seeks to understand how the stem fragments were broken through the identification of certain breakage patterns that correlate with specific behaviors of pipe disposal. The proposal that was tested were that the fragments from the Mount Pleasant Site were either broken intentionally or accidentally, and the hypotheses used to guide the investigation, were that, depending on how the stems were broken, there will be differences in the lengths and quantities of stem fragments as well as different stem end breakage patterns. The statistical data of stem fragments from the Mount Pleasant Site were first statistically compiled and then compared to the systematic breaking of 61 historic reproduction pipes in two experiments. The results of this study indicate that while there is overwhelming evidence for the accidental breaking of pipes at the Mount Pleasant Site, the intentional breaking of the pipe stems also did occur as can be identified by the breakage patterns on stems that identify these pipe disposal behaviors.

ACKNOWLEDGEMENTS

Without the support of an *Undergraduate Research Grant from the University of Wisconsin-La Crosse*, the purchase and constructive breaking of historic reproduction clay tobacco pipes would not have been possible. For providing me with the reproduction pipes, the company of *Williamsburg Pottery*, and for making it all happen with her exceptional patience, *Mary Johnson*. The *Mississippi Valley Archaeology Center* for catalog materials. My Advisor, *Dr. Tim McAndrews,* for his positive support throughout this thesis process, his creative insights, and most importantly, for his encouragement to break pipes! For the support, critique, and methodological guidance on how to break the pipes, *Dr. Jim Theler* and *Vicki Twinde-Javner*. For technological and statistical assistance, *Dr. Constance Arzigian.* To *Chris Driver*, who was gracious enough to take the time to photograph both experiments. I would like to thank *all those who took part in breaking the reproduction pipes* in both experiments...for without your "breaking expertise" I would not have a thesis! Also, to *Mike Bednarchuk* for your much valued insights and support. And finally, *Mom*, *Dad*, and *Joe*—for instilling within me the passion for life, love and learning…. "*Veni Vidi Vici.*"

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